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1954-1955 **Bul. 490**

MASSACHUSETTS AGRICULTURAL EXPERIMENT STATION
UNIVERSITY OF MASSACHUSETTS
AMHERST

MASSACHUSETTS AGRICULTURAL EXPERIMENT STATION

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	Hatch	Adams	Purnell	Bankhead-Jones 5	Bankhead-Jones 9b1-2	Bankhead-Jones 9b3	Research & Mkt. Title II	Non-Federal Funds	Total
				RECEIPTS					
Received from U.S. Treas.	$15,000.00	$15,000.00	$60,000.00	$36,698.19	$95,538.52	$50,200.00	$5,089.81		$277,526.52
State Appropriation								$550,598.80	550,598.80
Special Industry								20,875.43	20,875.43
Balance Forward								41,559.51	41,559.51
	$15,000.00	$15,000.00	$60,000.00	$36,698.19	$95,538.52	$50,200.00	$5,089.81	$613,033.74	$890,560.26
				DISBURSEMENTS					
Personal Service	$8,203.20	$15,000.00	$43,425.60	$30,946.23	$56,143.01	$25,080.59	$2,657.27	$513,876.67	$695,332.57
Travel	740.38		791.06	426.46	2,394.17	2,225.17	158.90	3,525.82	10,261.96
Transportation of Things	3.23		36.89	74.50	220.81	235.01		2,011.72	2,582.16
Commu. Service	1.36		.22		8.81	.50	38.54	19,043.94	19,093.37
Rents and Utility Service	6.12		260.00					13,803.57	14,069.69
Printing	517.85				3.75			5,056.29	5,577.89
Contractual Services	1,611.52		5,192.00	185.40	7,227.32	7,442.43		5,172.85	27,371.52
Supplies and Materials	1,591.08		4,147.60	2,536.82	19,752.80	5,415.38	77.29	17,291.07	50,812.04
Equipment	2,325.26		6,146.63	2,528.78	9,787.85	9,734.18		1,898.26	32,420.96
Balance						66.74*	2,157.81	30,813.55	33,038.10
	$15,000.00	$15,000.00	$60,000.00	$36,698.19	$95,538.52	$50,200.00	$5,089.81	$613,033.74	$890,560.26

*Returned to U. S. Treasury

DEPARTMENT OF AGRICULTURAL ECONOMICS AND FARM MANAGEMENT

ADRIAN H. LINDSEY IN CHARGE

Public Landownership in Rural Areas of Massachusetts. The results of the project on public landownership in rural Massachusetts can be summarized as follows: (1) Public lands comprise more than 10 percent of the total area of the Commonwealth. (2) Sixty-three and one-half percent of the public land is owned by the State; 26.2 percent, by municipalities; and 9.9 percent, by the federal government. (3) Forest and wildlife reservations form 53.9 percent of the state-owned land; 29.8 percent is in water systems and sewerage. (4) Tax exempt property comprises more than 25 percent of the total valuation in 48 towns; 15 to 25 percent, in 66 towns. (5) Although most public land is of poor quality or woodland, some good agricultural land is included.

— *David Rozman.*

Population Changes in Relation to Agriculture and Land Use in Rural Areas. Work in this study has been centered on the classification and tabulation of data, including several major areas of information, preparatory to the regional and state analyses. The first body of information is concerned with total population growth from 1900 to 1950, and deals with distribution by age, sex, ratio of dependency, and classification by color in metropolitan and nonmetropolitan counties. The second concerns population changes between 1940 and 1950. The characteristics of the population were further analyzed from the standpoint of urban, rural-farm, and rural-nonfarm groupings.

— *David Rozman.*

Profitability of Alternative Forage Programs on Specific Farms. Records of the 83 farms in the New England Green Pasture Program for 1950-54 have been analyzed. All farms were proficient in producing high-quality forage. Other characteristics were highly variable. Size of farm ranged from a one-man to a 30-man operation. In production efficiency, the farms operated at a higher average intensity than the average of all New England farms: milk production per cow was 9976 pounds; animal units per man were 19.2; and feed crop acres per hay-eating animal unit were 2.09. Fertilization per acre and forage fed per cow were at rates above New England averages.

On 33 Massachusetts farms where intensive forage removal was studied four distinct practices appeared: (1) daily chopping and hauling to cows; (2) periodic mowing of long grass and hauling to cows; (3) strip grazing; (4) feeding silage during the summer. Average feed-crop acres per animal unit on these farms were similar to those on the 83 Green Pasture Program farms. No relationship of yearly milk production to forage removal practices is evident. Success of such a program depends largely upon the manager's ability to obtain economical increases in yield with more intensive use of land, fertilizer, labor, and machinery.

—*B. D. Crossmon, Johannes Delphendahl, and Ruth M. Wentworth.*

A Study of Chore Labor and Service Buildings on Dairy Farms. Milking operations were timed on 22 Massachusetts farms that varied from farms with the newest innovations in loose housing, milking rooms, milk pipe lines, and bulk tanks to prevailing stanchion barns with older equipment. Man-minutes per cow per milking ranged from 2.12 to 5.65.

The most rapid milking of cows by one operator, 58.5 Holsteins an hour, occurred in a U-shaped milking room with four elevated side entrance stalls. An assistant prepared the cows for milking. When the two operations of preparation and milking were performed by one operator, as was the situation on most farms, the most rapid performance was the milking of 66 Holsteins in just over one and one-half hours. This operator, in a new stanchion barn, with parallel tieups and a pipeline to the bulk tank, used four single milking units.

—B. D. Crossmon and Ruth M. Wentworth in cooperation with H. N. Stapleton and Allen Barton of the Department of Agricultural Engineering and Thayer Cleaver of the U.S. Department of Agriculture.

Production Adjustments on Representative Massachusetts Farms. Representative Massachusetts farms have been studied to determine the effects of important changes in technology, prices, and institutional policy on farm income.

1. *Adjustments on Apple Farms.* The prevailing organizations and operations of five representative apple farms have been determined. Probable income changes from several production adjustments were projected for these farms.

2. *Labor Changes on Cranberry Bog Operations.* Twelve years of hired labor have been analyzed by operations for a representative bog operation. Model hired labor appeared as three hours per barrel for regular labor and one hour per barrel for harvest labor. For the last four years a picking machine was used, and harvest labor dropped below an hour per barrel.

3. *Keeping Poultry Layers a Second Year.* Extremely low poultry and egg prices in 1954 led many poultrymen to consider keeping layers a second year. A detailed evaluation indicated that the most important variables involved were the price of eggs, salvage value of fowl, cost of feed consumed, rate of bird removal, and rate of lay. When 22 different combinations of these variables were considered for a 3,000-bird laying flock, the results indicated: (1) at the lowest egg and poultry prices of 1954-55, less loss would occur if layers were kept a second year; (2) some replacement is necessary to maintain capacity; (3) with more favorable price-cost relationships than in the Fall of 1954, higher profits occurred with replacement of birds at the end of one laying year. These generalizations will need to be modified by the conditions facing any particular farmer considering this adjustment.

4. *Adjustment to Multi-Quart Milk Containers.* Producers trying to capture part of the prevailing dealer spread by introducing multi-quart (gallon and half-gallon) containers have caused an upheaval in Massachusetts milk marketing, particularly in the Springfield area. Quantity discounts are now available to consumers.

A few producers have made a relatively simple adjustment selling raw milk in multi-quart containers at their farms. More producers have

met consumer or institutional demands for pasteurized and homogenized milk. With expansion of facilities and services, the question arises whether the new producer-dealers can continue to compete efficiently against well-established larger dealers.

—B. D. Crossmon, R. O. Aines, Ruth M. Wentworth, and W. Cook, Jr.

Economic Analysis of the Organization and Operations of Connecticut Valley Cash-Crop Farms. Mechanized harvesting methods of onions, cucumbers, and tobacco are being compared with conventional hand methods. Hand topping of onions averaged 6 bushels per man-hour. Mechanical onion harvesters picked up, topped, and sacked onions at rates ranging from 14.4 to 30 bushels per man-hour. With more machine topping rolls, output per man increased.

Machines sizing cucumbers averaged 2 bushels per minute, freeing producer time for other operations.

Initial study of a custom-built tobacco-spearing machine shows precision spacing of plants on lath, with less fatigue than with hand-spearing. Present machine ownership costs appear uneconomical on farms of less than 25 acres.

—J. W. Callahan and B. D. Crossmon.

Market Outlets for Livestock in Massachusetts. A random sample of 34 Massachusetts farms indicated that 50 percent of the dairy cattle and calves were sold through auctions during 1954: 33 percent to dealers, 10.7 percent to farmers, and 6.3 percent to terminal markets. Thirteen farms reported additional sales of beef cattle, sheep, and hogs.

Judging from a sample of 31 livestock dealers, the Brighton Stockyard appears to be the principal outlet in eastern Massachusetts. Central and western Massachusetts dealers confined their sales mainly to farmers, packing plants, and auctions located in their areas and in eastern New York.

The four Massachusetts livestock auctions, three private and one cooperative, reported gross sales of 1.26 million dollars in 1954.

—E. W. Bell and J. W. Callahan.

Country Point Price Reporting. A method of reporting country point prices for McIntosh apples was developed and put into practice during the 1952 and 1953 marketing seasons. The method is designed to provide buyers and sellers with shipping point price and to supply information on apples of various qualities and on packages moving through many outlets in principal market areas.

—R. A. Fitzpatrick.

Marketing New England Flowers through Wholesale Channels. This is the first study ever undertaken in this field in New England. It is supported jointly by the Agricultural Marketing Service, the Northeast Regional Research program, and the Massachusetts Experiment Station. Preliminary research indicates that gross farm receipts from Massachusetts florists and nursery crops in 1953 totaled approximately 23 million dollars, or 11 percent of the total farm receipts in the State. The industry ranked third among the state's farming enterprises.

Carnations are the most important flower crop, accounting for nearly one-half of the value of cut flowers grown under glass. Massachusetts led the country in 1949 with the production of 35 million blooms. Present production is close to 50 million blooms. In 1954-55, 73.5 percent were sold on consignment, 9.7 percent direct to retail florists, 8.1 percent to city wholesalers, 6.6 percent on growers' market at the Boston Flower Exchange, and the remaining 2 percent to peddlers and other outlets.

Boston received 41 percent of the carnation growers' shipments; other markets in the state received 7 percent. The remainder (52 percent) was shipped out of state: 20 percent to the South, 10 percent to upstate New York, 7 percent to the Midwest, 12 percent to the New York City, Philadelphia, and New Jersey markets, and 3 percent to other New England states.

Carnation grading shows little uniformity because of the absence of established grade standards. Of 69 growers reporting, 3 used four grades; 40, three; 22, two; and 3, one grade, with one not specifying. Grade standards would benefit the industry in the opinion of 41 growers; 14 thought it would not; and 14 had no definite opinions. Thirty-eight growers thought price differentials sufficient to encourage rigid grading, 25 thought not, and 6 were undecided. Eighty-five percent of the growers saw a definite need for more timely and accurate market information.

—R. A. Fitzpatrick, Elmar Jarvesoo, and Sonja Bergquist.

Wholesale Milk Route Study. Thirteen wholesale routes were studied to determine the effect of such factors as load size, wage costs, and size of orders on efficiency. The results will aid in high-lighting the methods by which cost-reduction efficiencies may be achieved.

The weekly driver wage cost averaged about $93.00. Delivery hours averaged approximately 50 per week. Daily loads averaged about 1000 units (quart equivalents of milk and half-pint equivalents of cream), and trucks traveled an average of 33.7 miles per day. An average of 39 customers were served per day with 29 units per delivery at a cost of about $.40 per customer or $.014 per unit.

The larger route loads tend to pay higher than average wage rates; yet they tend to have the lowest cost per unit. Correlation of size of customer order with units delivered per hour leaves no doubt that units delivered per hour can be increased substantially by increasing the size of orders. Use of a more definite pattern of quantity discounts in line with differences in delivery cost would discourage split-stops, would encourage every-other-day orders from small volume customers, and hence would permit larger loads.

—H. G. Spindler.

Economics of Bulk Tank Handling. Costs and related data are being determined to aid producers in deciding whether to buy bulk tanks, in determining what size tanks are needed, and in evaluating the feasibility of every-other-day pickup. In general, these data will help crystallize the potential added costs and savings for bulk tank manufacturers, sales agencies, farmers, haulers, and milk dealers.

The hundredweight tank cost for a 20-can-per-day producer will approximate $ .05; whereas, for a five-can (average) or a two-can (small) pro-

ducer, costs run $0.11 and $0.17, respectively. Bulk tanks will not force the small producer out of business, but, as with any other piece of equipment, if the number of units involved is small, the cost per unit is inevitably large.

—H. G. Spindler.

Milk Price Relationships in Massachusetts Markets. A comparative study of Boston prices with Springfield, Worcester, Merrimack Valley, Fall River, and New Bedford on fluid, surplus, and producer milk is being extended from 1951 to 1954 so that a 20-year comparative price series will be available. The manuscript on milksheds and location theory prices has been divided into two documents: one on the development of balanced prices between markets, and the other on actual prices, their differences, and analysis of the factors causing differences in prices.

The financial effect of not using all the nearest supplies in fluid form, inequality in returns to producers, and costs to dealers resulting from disalignment of prices are emphasized.

—H. G. Spindler.

Freight Rates on Feed. Buffalo, New York, is an important source of mixed feed for farmers as well as a major source of ingredients for feed mixers throughout New England and the Middle Atlantic States. Rates from that point to the East presumably reflect Buffalo's location on the lake and are a principal factor in the grain rate structure under which feed moves. Data accumulated from the Interstate Commerce Commission, imports, railroad tariffs, and private files substantiate this hypothesis.

The relationship is a complicated one. Water rates are effective only during the open season, and even then the availability of space in the lake bulk-carriers depends on the demands for ore and limestone. Lake rates on grain vary inversely with this demand for space.

Additional factors affecting rates from Buffalo to the East are the competitive positions of the carriers. Some lines from Buffalo have trackage from Chicago and other Illinois points and can handle grain all-rail from Central Territory points. Other lines out of Buffalo are dependent on their connections from the West. The competitive position of the carriers is, furthermore, intertwined not only with that of the commercial interest of these two cities but that of other lake ports.

—A. A. Brown.

Live Poultry Marketing. A major difficulty in fowl marketing recurs each fall when the need for space for housing pullets reaches a peak. For example, 50 percent of the supply was estimated to have been marketed during the months of August, September, and October of 1953. The chief concern of Massachusetts flock owners, however, is that egg prices, particularly prices for larger eggs, in these months generally are at a seasonal high. The need is to manage flocks in such a way that birds will be producing during the months of high egg prices, and yet flock owners will not be confronted with a glutted fowl market. Early hatched chicks, then, are a basic consideration.

—A. A. Brown.

DEPARTMENT OF AGRICULTURAL ENGINEERING

A. B. BARTON IN CHARGE

Forage Handling Mechanization. On hand-worked test plots, the Department of Agronomy made two findings of economic value in regard to forage handling: first, the yield is increased when the soil is subjected to pressures no greater than those imposed by normal human foot pressure; second, the yield and quality are increased as the crop is cut before it reaches a height of 12 inches. The purpose of this project was (1) to determine whether these findings could be obtained on a scale comparable to a normal farm operation, and (2) to develop machinery that would have a capacity greater than its present capacity and, if possible, that would require an expenditure of fewer man-hours in the total operation.

In the part of the study on soil compaction, all machinery was equipped with oversize tires so that ground pressures could be maintained at or below 10 pounds per square inch. To aid in the fitting of the tires to the machinery, a tire tester was constructed to determine the load, inflation pressure, and deflection relations of available tires. A soil bulk density tester was made for field use to determine actual soil compaction caused by machinery operation.

A rotary cutter-type field chopper was used for making silage, and the same chopper, with modifications, was used for the hay-making operation. The results of this study indicated that in crop preparation for hay this field chopper has reduced the field drying-time by a significant amount and that oversize tires have helped to overcome soil compaction.

—E. Johnson, M. Drake, J. Steckel, M. L. Blaisdell, and A. B. Barton.

Refrigerated Fruit Storage. To study the effect of anti-scald oil coatings on the cooling rate of apples, samples of Cortland and Greening apples were coated with an oil to prevent storage scald. The apples were coated by two methods: one method was to dip the apples by hand into the oil solution; the other method was to apply the oil in a spray while the fruit was still on the trees. Preliminary results indicate that the hand-dipped apples took longer than the sprayed apples to cool from 60°F. to 37°F. The average percent difference in cooling time between treatment and control for the hand-dipped apples was 3 percent; for the sprayed apples, it was 1 percent. *—J. W. Zahradnik.*

Low Cost Poultry Housing. During the past year the experimental poultry house was operated at a bird density of one bird per square foot. Lack of floor space necessitated mechanical feeders, automatic waterers, and community-type nests. The open front was modified to eliminate the extreme inside temperatures registered during the previous winter. Inside air temperatures were held to a minimum of 20°F. Results to date indicate low mortality (10 percent), high percentage of clean eggs (95 to 97 percent), low labor time (15 minutes per day), and normal but irregular yearly egg production for the strain of bird (55 to 60 percent). Production of 65 to 70 percent was maintained during May, June, and July under very severe temperature conditions.

Operation of the structure and additional laboratory tests indicated the possibility of reducing building costs through more efficient use of materials. However, it appears that a minimum cost of structure would be based not only on material costs, but also on bird density, insofar as it becomes necessary to mechanize the operation because of crowding.

—A. B. Barton.

DEPARTMENT OF AGRONOMY

WM. G. COLBY IN CHARGE

Control of Damping-off in Forage Seedings. Five different fungicides were tested on alfalfa, red clover, Ladino, birds-foot trefoil, orchard grass, Canary grass, brome grass, millet, and Sudan grass. Diseases in the form of pre-emergence damping-off occurred only in the earlier seedings of millet and Sudan grass and were readily controlled by seed treatment with Arasan and Panogen.

— *H. G. Joa.*

Competition for Plant Nutrients between Field Corn and Weeds. Because of weed competition, the potassium content of corn decreased more than the nitrogen content. Apparently, competition for potassium is more evident and, under low potassium soil level, is responsible for the decreased corn yields.

—*Jonas Vengris.*

Weed Control in Grass-Legume Seedings. Experiments with and without a nurse crop indicate that under conditions of heavy infestation with dicot weeds, Dinitro herbicide can provide substantial help in establishing new seedlings.

—*Jonas Vengris.*

Quackgrass (*Agropyron repens*) **Control.** Maleic hydrazide, as well as Dalapon, satisfactorily suppressed growth of quackgrass in field corn when applied seven days before corn planting.

—*Jonas Vengris.*

Chemicals in Renovation of Deteriorated Grasslands. In killing weedy perennial grasses, the most promising materials were Dalapon and TCA. The effectiveness of these chemicals may be significantly reduced if heavy rains follow their application.

—*Jonas Vengris.*

Soil Fertilizer Phosphorus. Studies on increasing the availability of soil phosphorus and applied phosphorus indicated that ammonium sulfate increased the uptake of superphosphate, whereas oxalate anion increased the uptake of soil phosphorus (the materials were added in direct contact with the applied superphosphate). Measured with corn in the greenhouse, the phosphorus "A" value of the ammonium sulfate treatment was 144, compared to 318 for the oxalate treatment. This indicates the superior effect of oxalate over ammonium ion in solubilizing soil phosphorus.

— *D. J. Albritton, Wm. M. Atwood, and J. E. Steckel.*

Breeding Improved Strains of Orchard Grass. Individual plants from superior families that breed sufficiently true to type were selected. Last year 4,500 pounds of seed from a late-maturing strain developed by the University of Massachusetts Agronomy Department were produced in western Washington for distribution to the farmers in the Northeastern States for trial purposes. Leafiness and lateness of maturity are two desirable characteristics that farmers have recognized in this strain.

—*H. M. Yegian and Wm. G. Colby.*

Evaluation and Use of Flint Lines in Flint-Dent Hybrids. An extensive series of selected new lines were selfed. About 40 restricted combination crosses of early inbred lines, recommended by the Northeastern Corn Conference, were made. Predicted double crosses from the previous year's results were tested. Several of these double crosses gave outstanding performances. They are being tested again, before any one of them can be introduced as a hybrid superior to Mass. 63.

—*H. M. Yegian.*

Usefulness of Soil Conditioning Materials in Tobacco Plantbeds. Peatbog muck, barnyard manure, hydrolyzed polyacrylonitrile (aerotil, krilium), and vermiculite (terralite), were tested as soil conditioners in tobacco plantbeds in 1954 and 1955.

The muck had the most beneficial effects on the structure of the soil and on the growth of seedlings. For greatest improvement the muck should be applied in the fall, about one inch deep, and worked into the soil thoroughly, before the soil is sterilized. However, the high acidity which peatbog muck may sometimes cause in the soil should be adjusted with lime to a level suitable for satisfactory growth of seedlings.

—*C. V. Kightlinger.*

Havana T48. Farmers who grew Havana T48 in 1954, and dealers and cigar manufacturers who bought and processed the tobacco produced by the strain, express strong approval of the strain. The acreage of T48 grown this year was greater than that grown last year.

—*C. V. Kightlinger.*

Irrigation Studies and Management of Irrigated Soils. Two three-quarter-inch irrigations of tobacco yielded 15 to 21 percent more than the controls, and increased the crop index 11 to 21 percent over the controls. Irrigation rates twice the above did not improve quality of yield over the check. Irrigation of tobacco at lesser rates but more frequently is better than irrigating at greater rates with longer time intervals. The yield of irrigated potatoes on six plots increased, ranging from 24 to 74 percent over the check. Second cutting of alfalfa hay with irrigation and fertilization yielded twelve times more hay than the check.

— *K. J. Kucinski.*

Farm Fish Pond Management. Large-mouth bass and bluegill fingerlings stocked during 1950, 1951, and 1952 in ponds not exceeding one third of an acre, produced 77 to 512 pounds per acre of edible-size fish. The application of 100 pounds of 10-10-10 fertilizer per acre at weekly intervals, or as needed, produced a satisfactory "bloom" (phyto-zooplankton) on the water. Stocking large trout in marginal-temperature ponds has not been too successful, but fingerling trout acclimated themselves well.

— *K. J. Kucinski.*

Potato Variety Trials. Seventeen potato varieties were tested for comparative yields, habit of growth, and resistance to disease. The five highest yielding varieties were Sacco, Kennebec, Pungo, Cherokee, and Green Mountains, ranging from 826 to 650 bushels per acre, respectively. The five varieties with the highest percent of total solids used as a measure of quality, were Tetons, Green Mountains, Merrimack, Delus, and Sacco.

— *K. J. Kucinski.*

DEPARTMENT OF ANIMAL HUSBANDRY

V. A. RICE IN CHARGE

Minerals in Cows' Milk. Milk from six cows fed alternately for a four-month period on a control ration and on a ration containing an aluminum supplement (potassium alum), was analyzed photometrically for its aluminum content. The control samples contained on the average 0.46 milligram of aluminum per liter; the samples obtained when the cows received the supplement averaged 0.81 milligram per liter. The average difference of 0.35 milligram was significant at the 5-percent level.

—J. G. Archibald.

Quality in Roughage. Results of analyses of a large number of samples of grass silage, accumulated in connection with our studies from 1937 to 1953, have been compiled, correlated, and summarized.

Preservatives in general lowered significantly the volatile base and butyric acid content of silage and significantly raised the content of lactic acid.

Quality in silage, as indicated by low pH, low content of volatile bases and butyric acid, and high content of lactic acid, was best attained by the addition of sodium metabisulfite, ground wheat, or hominy meal.

Sugar content was much higher in silage preserved with either liquid sulfur dioxide or sodium metabisulfite than that in silage preserved by any other method.

Excellent quality grass silage was made by using Kylage (a proprietary mixture containing calcium formate and sodium nitrite) at the rate of 5 pounds per ton of green grass, but dry matter losses were rather high (21.2 percent).

The pilot test mentioned in last year's report, in which sufficient grain was added to the grass at ensiling time to provide for the needs of beef cattle and young stock, thus reducing the feeding chores to one operation, was tried on a much larger scale this year. The product was excellent in every respect; 46 animals gained an average of 1.12 pounds daily over a period of 45 days, and dry matter losses due to the ensiling process were only 9 percent, the lowest ever noted here. Four hundred and forty pounds of a 14-percent protein mixture were added to each ton of green grass.

—J. G. Archibald.

Causes and Prevention of Dairy Cattle Sterility. During the past year the department, in cooperation with other experiment stations in the northeast, investigated some of the factors involved in dairy cattle sterility, a major source of loss to Massachusetts dairy farmers. Fifty-eight cows and heifers with normal and abnormal reproductive histories were slaughtered to obtain timed embryos between 15 and 30 days of gestation. This enables us to study the incidence of early embryonic mortality and to provide data concerning the relative importance of the ovaries, the adrenals, the uterus, the placenta, and the embryo itself in the sterility problem. The embryos are being serially sectioned, and histological and histochemical studies are being conducted to establish the normal morphology of the tissue from various parts of the reproductive tract.

—R. C. Foley and J. S. Greenstein.

Physiology and Reproduction of Dairy Cattle. As one approach to the problem of infertility in dairy cows, patterns of blood serum protein fractions analyzed by paper electrophoresis are being examined for possible alterations correlated with normal and abnormal estrous cycles and pregnancies.

—W. G. Black.

Effect of Aureomycin Supplement on Growth Rate and Carcass Grade of Beef Calves Wintered on Hay and Grass Silage. On a hay and grass silage ration with no grain supplement, aureomycin did not enhance growth rate of steer calves during a 120-day winter feeding trial. On removal of aureomycin from the ration the steers suffered an appreciable weight loss.

—J. M. Elliot, N. S. Hale, and D. M. Kinsman.

Comparison of Three High-Roughage Rations for Wintering Ewe Lambs. Grass silage proved a satisfactory feed for wintering ewe lambs, if supplemented with a small amount of grain. On a ration of grass silage and hay with or without grain supplement, aureomycin did not significantly enhance growth rate of lambs.

—J. M. Elliot, N. S. Hale, and D. M. Kinsman.

Effect of Various Silages on Fatty Acid Levels in the Mature Bovine Rumen. Two cows have been permanently fistulated and fitted with plastic cannulae in order to study the effect of various silages on volatile fatty acid levels in the bovine rumen.

—J. M. Elliot.

Growth Response of Lambs, Implanted with Pellets Containing a Combination of Progesterone and Estradiol, when Fattened on Pasture and Limited Grain. This project, now underway, was prompted by requests for such information from breeders and feeders in the State.

—L. N. Baker, B. E. Colby, and D. M. Kinsman.

Feeding-Management Practices in the Utilization of Cooked Garbage for Pork Production. In the first phase of this project, seasonal variation in the chemical composition of three types of cooked garbage will be determined: municipal, restaurant, and institutional.

—L. N. Baker and B. E. Colby.

DEPARTMENT OF BACTERIOLOGY

R. L. FRANCE IN CHARGE

"Come-Up" Time Milk Pasteurization. Using the "come-up" time milk pasteurizer, it has been determined that 99.9 percent of a heat resistant micrococcus, MS-102, was killed at 88.8°C. for 0.5 second heating time, and 89.4 percent for 0.25 second heating with no intended holding period. One hundred percent destruction of *Escherichia coli*, ATCC 9637, *Salmonella typhosa*, ATCC 9498, *Shigella paradysenteriae*, ATCC 9580, and *Streptococcus pyogenes*, ATCC 7017, was obtained at 78.5°C., 72.5°C., 72.2°C., and 70.4°C., respectively, for 0.25 second heating, and 79.8°C., 73.8°C., 73.5°C., and 72.5°C., respectively, for 0.25 second heating. In all cases the initial count of the test strain was between 2 and 7 million per milliliter. All results were obtained using milk as a suspending fluid.

—Warren Litsky, R. B. Read, Jr., in cooperation with D. J. Hankinson, Dept. of Dairy Industry.

Investigations to Determine Whether the "Come-Up" Time Pasteurizer Will Sterilize Suspensions of Bacteria without Altering Their Physical Properties. Suspensions of *Serratia marcescens*, with an initial total count of approximately 50 x 10^9 per milliliter, were sterilized in the "come-up" time milk pasteurizer at a temperature of 176°F. with a heating time of 0.33 second. Physical properties, such as viscosity, surface tension, pH, percent solids, and cellular characteristics, showed little or no change after the heat treatment.

—Warren Litsky and Neil Norcross

Attempts to Improve the Efficiency of Farm and Commercial Vinegar-Making Methods. In last year's annual report, it was suggested that an unknown growth factor for the acetic acid bacteria may be present in yeast and its derivatives. From qualitative data, this factor is soluble in water, alcohol, and butanol, and apparently heat-stable at ordinary pH. It is destroyed, however, when treated with strong acids and alkalis at high temperature.

—Warren Litsky and Charles Goldman, in cooperation with W. B. Esselen, Dept. of Food Technology.

Bacteriological Study of Sewage Disposal Plants. Water samples were collected in areas of high and low pollution along the Connecticut River during a two year period. It was found that the enterococcus density was approximately 7.6 times that of *Escherichia Coli*. By statistical analysis, a definite relationship was demonstrated between the two types of organisms, in that an increase in the *Esch. coli* index is generally followed by a predictable increase in the enterococcus index. A positive correlation of +0.84 was shown between the two types in the samples collected.

—Warren Litsky.

Effect of Terramycin in Combination with Other Antibiotics on Fecal Flora. The effect of broad-spectrum antibiotics on the number of *Lactobacilli* in feces was determined. No positive correlations or effects may be noted at present.

—Warren Litsky, in cooperation with J. R. Cohen, Pathology Laboratory, Springfield Hospital.

Comparative Statistical Study of Certain Methods for Bacteriological Testing of Water. A statistical year-round comparative study of results obtained from the millipore filter and of results from other standard procedures has been in progress only a few months. Data are insufficient to report.

—*R. L. France, J. E. Fuller, and Warren Litsky.*

Nitrification Studies with Sewage Sludge. Addition of dried sewage sludge to soil did not interfere with decomposition and nitrification of dried blood and cottonseed meal added to the soil. The sludge appeared to contribute some additional nitrate.

—*J. E. Fuller.*

Activities of Soil Microorganisms with Relation to the Availability of Phosphorus in the Soil. Attempts were made to induce chelating action in the soil by adding organic substances that would be converted to organic acids by soil microorganisms and thus free the phosphorus. No significant results have been obtained to date.

—*J. E. Fuller.*

Production of Marketable Organic Chemicals by the Microbic Decomposition of Wood Wastes. This project has been inactive during the year. New work has been started to investigate composting.

—*J. E. Fuller.*

DEPARTMENT OF BOTANY

T. T. KOZLOWSKI IN CHARGE

Properties and Importance of some Fungus and Virus Diseases of Carnations and their Control Measures. The indexing of 2000 flowering stalks of the William Sim variety, released eight years ago, indicated that up to 40 percent of a single day's harvest might be infected with carnation mosaic. Preliminary transpiration and water uptake trials indicated that virus-infected flowers absorb more water and have a lowered keeping quality. Chemical soil treatments applied as drenches were not so effective as steam but were superior to no treatment in controlling the soil-borne fusarium wilt fungus.

—*E. C. Gasiorkiewicz, Waltham.*

Effect of Carnation Mosaic, Carnation Streak, and Carnation Yellows on the Production of Carnation Flowers. Observations over a nine-month period showed no movement of streak virus by root transmission when carnation-streak-infected William Sim plants were grown alongside virus-free Yoder # 115 seedlings. Transmission of these viruses by grafting is now under investigation.

—*E. C. Gasiorkiewicz, Waltham.*

Properties of Carnation Mosaic Virus. Comparative trials of clarification and purification procedures indicated that the procedure for extracting carnation virus was not so important as the indicator plant used for the bioassay. Ten sources of carnation mosaic virus screened on 10 varieties of *Dianthus barbatus* L. (Sweet William), showed differences in the incubation period and in symptoms. Giant White, Sweet William variety, was the most responsive to virus inoculations. Electron microscopy with fresh plant extracts confirmed the spherical morphology of the mosaic virus. The appearance of a smaller spheroid particle about one half the diameter of mosaic virus warrants investigation. Inoculations with carnation mosaic virus were more successful on growing Diantus plants than on detached leaves.

—*E. C. Gasiorkiewicz, Waltham.*

Chemical Soil Treatment for the Control of Carnation Fusarium Wilt Caused by *Fusarium oxysporium f. dianthi.* Eight proprietary compounds did not affect the pH, the availability of essential elements, or the soluble salt levels of the soil. None of the treated plots equalled the steam-treated checks in flower production. Six treatments gave higher yields than the inoculated plots. Crag 974 was phytotoxic because of the presence of formaldehyde in the sample under test. Indications are that chemical applications have merit in preventing the spread of disease organisms, but none to date eliminate the soil-borne pathogen as efficiently as steam.

—*E. C. Gasiorkiewicz, Waltham.*

Determinations of Fungus and Bacterial Pathogens in Commercial Propagating Stock of Geraniums. A successful procedure for culturing geranium cuttings has been developed. Sodium hypochlorite (1:20) solution was the best surface disinfectant. Incubation of tissue segments on potato dextrose agar at 89.2°F. (32°C.) for seven days gave

uniform isolation results. Geranium cuttings were stored at 31°F. (−0.56°C.) in polyethylene wrappers during the incubation period. Eighty-five percent rooting of cuttings was obtained following storage. Lowest incidence of bacterial fungus pathogens was in the new varieties, and highest in the older, commonly grown commercial varieties like Ricard and Fiat.

—*E. C. Gasiorkiewicz, Waltham.*

Determination of Fungus and Bacterial Pathogens in Commercial Propagating Stocks of Carnations. Laboratory culturing of carnations to initiate mother blocks will guarantee stock free of bacterial and fungus pathogens. Mother blocks observed for 36 months showed no losses or subsequent systemic reinfection when sanitation and pest control for pathogens and insects were maintained. Zineb and Malathion sprays were effective in maintaining healthy mother blocks.

—*E. C. Gasiorkiewicz, Waltham.*

Investigations of Fungicides that Promise Value in Apple Disease Control. Wettable paste sulfur and Phygon combined with superior type oils at delayed dormant were injurious. Dry wettable sulfur, Thiram, Captan, Ferbam, and Glyodin with oil were safe. Captan following superior type oil was safe. Ferbam in sequence with mercury was safe. Phygon, phenyl mercury, and epsom salts russetted Baldwin, R. I. Greening, and Red Delicious apples. Glyodin has russetted Baldwin apples two years in succession. The other fungicides have not affected fruit finish. Captan caused a significant leaf-spotting of Delicious foliage, and when Captan followed other fungicides, leaf-spotting on Delicious was the same throughout the various treatments.

Half-strengh phenyl mercury combined with half-strength Glyodin, Ferbam, or Captan gave efficient scab protection and scab eradication without injury. In one instance half-and-half mercury and Glyodin in two applications caused heavy leaf and fruit drop. Epsom salts and NU Green were used in combination with various pesticides after mid-June without injury.

—*E. F. Guba, Waltham.*

Infection Cycle and Control of Peach Canker Caused by the Fungus *Fusicoccum amygdali* Delacr. Spore inoculum of the fungus is present in abundance throughout the vegetative season and cause new infections of the current season's wood. Major infection periods during the growing season are associated with rainfall. In 1954, serious infections followed the hurricanes of late August and September and later periods of rainfall after fruit harvest. Cankers appear about the nodes of the suckers in two to three weeks. Other infections have a longer incubation period, and the disease may not appear until the next spring season. A major infection occurred in the rain and hail storm of June 16, 1955. The injuries in the twigs caused by hail were badly infected in the same storm period by *Fusicoccum* in the absence of protection with fungicide. The infection cycle now appears to be well understood. We have been able to show control, with protectant spray, of all infections except post-harvest infections, which have been overlooked in the control program; their control with protectant sprays is being planned for this year.

—*E. F. Guba, Waltham.*

Breeding Forcing Tomatoes for Resistance and Immunity to Cladosporium Leaf Mold. Two successive generations of Waltham Mold Proof Forcing 2-22 and 54 have been grown since the last report. The last generation progeny showed 3.7 and 5.6 percent susceptibility. In the spring season of 1955 the progeny was pure for immunity. The objective of breeding acceptable forcing tomatoes immune to leaf mold has been accomplished. Waltham Mold Proof Forcing has been crossed with Canadian V-546, 547, and 548 (immunity from *Lycopersicon hirsutum*). Other out-crosses were made to Canadian V-511, 512, and 545 (immunity from other sources).

Our completed studies have combined desirable horticultural type with immunity to *Cladosporium fulvum* derived from *L.hirsutum*, *peruvianum* and *pimpinellifolium*. The immunity of Waltham Mold Proof Forcing and resistance of Improved Bay State are dominant. The Department of Olericulture is promoting seed production of first generation hybrids of our Waltham tomatoes and susceptible types, such as Michigan State, for hybrid vigor and higher yields.

—*E. F. Guba, Waltham.*

Systematology, Ecology, and History of Monochaetiae and Pestalotiae. One final section of this contribution to taxonomic mycology remains to be organized and typed. Nine sections are completed, and most of them have been critically examined by J. A. Stevenson, Plant Disease Epidemics and Identification Section, U. S. Department of Agriculture. An index to the entire publication is also contemplated. Investigator's contribution should simplify our understanding of the Monochaetiae and Pestalotiae fungi. Taxonomy, synonomy of names, history of the species, pathological considerations, illustrations, and keys are being combined in one comprehensive monograph.

—*E. F. Guba, Waltham.*

Root Diseases of Parsnips and Control Measures. Heaving of parsnip roots in spring season is variable among varieties. Round and thick-crowned types heave badly and coincidentally show most injury and decay on digging. Forking roots or crabs are also a varietal abnormality relatively absent in some varieties and serious in others. In these respects, the varieties Model, Tender, and True are preferred. Crown is inferior. "Rust" of parsnip roots appears to be of fungous origin, but pathogenicity has not been demonstrated by the usual technique of culturing and inoculation. Itersonilia, Cercospora, Cercosporella, and Ramularia leaf-spotting pathogens have been more accurately defined. Cercosporella and Ramularia pathogens are identical, and Cercosporella is accepted as the correct name. Itersonilia grows best in acid and neutral environment, in wet water-logged soil. Parnsips grow well in a pH range of 5.4 to 7.2. Liming land and culture on ridges and raised beds have given good control. Various organic fungicides (20 percent active) applied between rows beginning in August were injurious to the roots and imparted an objectionable taste. Sclerotinia watery soft rot is serious in badly infested land and under persistently moist conditions; control with calcium cyanamid is under study.

—*E. F. Guba, Waltham.*

Damping-off and Growth of Seedlings and Cuttings of Woody Plants as Affected by Soil Treatments and Modifications of Environment. Cuttings were obtained from superior white pine trees which the Department of Forestry wishes to have propagated vegetatively. Cuttings of white pine rooted in larger percentages when collected in late January rather than earlier in the winter. Cuttings taken in April rooted fairly well. Cuttings taken in late winter rooted in less time than those taken earlier. In almost all cases, white pine cuttings rooted in larger percentages after treatment with the fungicide Captan (N-trichloromethylthiotetrahydrophthalimide) used with indolebutyric or naphthaleneacetic acid than after treatment with the root-inducing substances alone. Powders made of Captan and indolebutyric acid 8 milligrams to 1 gram of talc, 1:3 or 1:6, or Captan-talc, 1:1, gave good results. Best rooting of cuttings from 14 white pines varied from 11 to 92 percent, indicating clonal differences in ability to root. Rooted cuttings are now under observation for subsequent growth differences. Scions from a superior white pine, the cuttings of which were unrootable, were successfully grafted on white pines in February and April. Cuttings of Colorado spruce treated with Captan and indolebutyric acid rooted better than those treated with the latter alone. Root-cuttings of beach plum were successfully taken from November through March. They showed clonal differences in rooting ability. Root-cuttings from plants four years old or less gave better results than those from older plants, and proximal parts of roots gave better results than the distal. Cuttings wholly buried grew equally well planted vertically or horizontally. Cuttings planted vertically grew better with the proximal end exposed.

—*W. L. Doran.*

Tobacco Frenching. Non-cropped land retains a factor that causes frenching of tobacco. An area of tobacco land was allowed to grow to weeds for four years with the idea of obliterating the frenching factor. Laboratory tests showed the factor was still present, and it gave intense symptoms of frenching. Fallowing the soil in late summer and early fall on another area failed to destroy the frenching factor. Christmas pepper and Jerusalem cherry do not frenching. These two plants, members of the tobacco family, showed no symptoms of frenching when grown in a frenching soil. Tobacco seems to be the only member of the Solanaceae that frenches, with the possible exception of tomato, which has shown slight and almost ephemeral symptoms.

—*L. H. Jones.*

Inducing Frenching in a Nonfrenching Soil. A soil was thoroughly tested and found not to contain the frenching factor. Using 2-gallon plant containers, an artificial water table was created by subirrigation about five inches below the soil surface. The first planting of tobacco showed no evidence of frenching. About six months after the initiation of the water table, a second planting of tobacco showed frenching in the containers in three to five days after exposure to the 35°C. (95°F.)soil temperature. However, frenching symptoms did not appear on tobacco plants grown under the same conditions, i.e., a high water table, but in soil autoclaved prior to use.

—*L. H. Jones.*

Chelated Iron in Nutrient Solutions. If a portion of the nitrogen in a nutrient solution is derived from ammonium sulfate, the nutrient solution becomes more acid. Ferrous sulfate, as a source of iron, is toxic to corn in such a solution. A ferrous form of chelated iron, monosodium ferrous complex of N-hydroxyethylethylene diaminetriacetic acid, proved to be a good source of iron with no indication of toxicity. When the amounts of iron were doubled, one half coming from ferrous sulfate and the other half from the ferrous chelate, healthy green corn plants were produced without any symptoms of toxicity.

—*L. H. Jones.*

DEPARTMENT OF CHEMISTRY

W. S. RITCHIE IN CHARGE

Spectrophotometric Characterization and Estimation of the Constituents of Certain Naturally Occurring Substances with Special Reference to the Carbohydrates of the Plant Cell Wall. The effectiveness of Anthrone in differentiating carbohydrates is being tested on mixtures of known composition by a study of the reaction rate curves and molecular extinction coefficients, calculated for the wave length of maximum absorption. Limited data indicate that a coarse differentiation can be made on mixtures containing different ratios of D-glucose, D-xylose and L-arabinose. When reacted with anthrone for one minute, this group of sugars, usually present in plant material in the random ratio of 1-1-8 exhibits maximum absorption at a wave length of approximately 612 millimicrons. Under these conditions a secondary maximum absorption peak also appears when either of the pentose units is present in major proportions; when the hexose predominates the secondary peak fails to appear. When reacted for two to seven minutes, the reaction rate curve becomes more complex and loses much leverage in characterizing mixtures of sugars. The greatest optical density is exhibited when xylose, glucose, and arabinose, respectively, are present in the major proportions.

—*Emmett Bennett.*

Production of Holocellulose from Nonwoody Plant Tissue. In this experiment holocellulose is produced chiefly to provide a source material for the investigation of hemicellulose. The yield of holocellulose depends upon the conditions employed. Thus, yields obtained from a reaction brought about in a boiling water bath for shorter periods are lower than those obtained at lower temperatuers for longer periods. Thus, at the higher temperature, more lignin is removed, which permits greater solubility of short chain carbohydrate polymers. The ideal, though difficult, point to reach is to leave just the right amount of lignin in *situ*. Preparative extracts may, therefore, contain variable amounts of hemicelluloses. It seems better, therefore, to recognize the potential loss and account for it in the extract. In the determination of cellulose (Bennett's procedure), the preliminary reactions involved in the preparation of holocellulose are utilized. In this procedure the end point is based on the disappearance of lignin as indicated by a color reaction; the complete removal of lignin is the goal. Since this involves the use of more drastic reagents in addition to those peculiar to the holocellulose determination, more short carbohydrate polymers are removed. Since the two reactions can be carried out as one or as two units, an accounting of the hemicellulose fraction removed can be made on the extract.

Preliminary tests in this laboratory indicated that isolated hemicelluloses were reasonably soluble in perchloric acid. This observation, the difficulties in extracting hemicelluloses, and the fact that this solvent works so well with starch prompted an investigation of the possibilities of perchloric as a solvent for hemicelluloses. The data accumulated for periods of extraction with 5 M perchloric for two hours at 25°C. indicate that this solvent is not selective in its action, that the removal of total solids proceeds at a faster rate than the removal of xylan, that the maximum loss of total solids is only about 80 percent of the xylan present, that the

xylan removed constitutes approximately 68 percent of the total loss, and finally that less than 60 percent of the xylan was removed. These data further serve to indicate the strength of the association of certain hemicelluloses with cellulose.

Cranberry pulp yields a cellulose which may contain approximately 30 percent "apparent lignin." Microscopic examination of this fraction revealed the presence of unimpaired polygonal cells of the epicarp. The walls of these cells are unusually thick due to the deposition of a cutinous substance, which apparently resists the action of the reagents used in the determination of lignin. The result obtained by accepted procedures thus leads to the erroneous conclusion that the cranberry "cocktail" pulp contains an unusually high content of cellulose which is highly lignified.

—Emmett Bennett.

Boron as Related to Soil Fertility. Study of the relationship between Ca-B ratio in the plant and root cation exchange capacity was continued. Plants studied differed widely in boron uptake from the same soil. In general those plants with roots of high cation exchange capacity contained much more boron than those with low cation exchange capacity roots. Severe deficiency symptoms of Red Sims carnation believed to be the result of boron deficiency were observed at Waltham Field Station. Deficient plants had Ca-B ratios of 1500:1 to 2000:1, whereas normal plants ranged from 300:1 to 500:1.

—Mack Drake.

Influence of Base Exchange Capacity and of Exchangeable Ions in Soils on the Availability of Potassium and Other Cations. Cation exchange capacity of roots of several vegetable crops were determined. Values ranged from a high of 65 milliequivalents for head lettuce, cucumber 54, carrot 52, red beet 51, muskmelon 49, celery 47, potato 38, onion 29.5, to a low of 16.0 for sweet corn. Plant roots having high cation exchange capacity adsorb the divalent cation Ca with much greater force than they adsorb K. The result is that plants with high cation exchange capacity roots adsorb Ca partially to the exclusion of K especially on soils low in available soil K. By increasing the level of available soil K and maintaining K at a high level throughout the growing season this preferential Ca adsorption is reduced, and enough K enters the plant for good growth. For example, one would expect that a higher level of available soil K would be required to produce 100 pounds of dry matter of head lettuce, cucumber, carrot, or beets (high cation exchange roots) than for sweet corn (low cation exchange roots).

—Mack Drake.

Yield and Mineral Composition of Forage Crops as Influenced by Soils and Soil Treatments. A study of the effects of harvest management of perennial forage crops in addition to fertility treatments on yield, persistence of stand, and chemical composition was started in 1954. Three cuttings in 1954 from the area strip-grazed in 1953 produced 3000 pounds more dry matter than the area rotationally grazed in 1953. Recovery period, height of harvest, and selective harvesting are more favorable to persistence of desirable species in the strip-grazing system. Orchard grass and Ladino clover cut at a 4-inch height recovered more rapidly than that cut at 2 inches. *—Mack Drake.*

THE CRANBERRY STATION
EAST WAREHAM, MASS.

C. E. CROSS IN CHARGE

The 1954 cranberry crop on the State Bog was 1100 barrels, about 70 percent more than the 45-year average. It was further remarkable in keeping quality, particularly the Early Blacks. The Massachusetts crop reached 585,000 barrels, about 15 percent less than the 1953 crop, but nearly 20 percent more than the 10-year average. Its size was particularly significant since it followed an all-time record crop, was considerably over-ripe when picked because of persistent September rains, and was considerably injured by July hail and August and September hurricanes. The national 1954 crop of 1,012,000 barrels is the second largest crop in history and the second consecutive million-barrel crop. Such heavy production has resulted in many market tensions, a substantial carry-over of fruit in freezers, depressed prices, and a narrowing of the margin of profit to growers. —*C. E. Cross.*

Weather Observations and Frost Forecasting. During 1954 the Cranberry Station witnessed a great variety of weather phenomena, data for which has been recorded daily. In the spring, in cooperation with the U.S. Weather Bureau, twelve frost warnings were issued for hazardous conditions on seven nights. Only six warnings were needed for hazardous conditions on three nights. Frost losses for the year did not reach a thousand barrels, probably because of prevailingly wet conditions in the spring and fall.

Extraordinary rains fell at times during 1954, contributing to an annual total of 50 percent above normal. Such rains flooded bogs on May 15 and 16, August 9 and 10, and September 10 and 11, causing an estimated loss of 2000 barrels, and, in the last rain, impairing the quality of many more.

More hail fell in 1954 in the cranberry area than in any year during the last 20 years. It is notable that most of the hail fell outside the usual "hail belt." About 6000 barrels of berries were lost in four storms.

Hurricanes Carol and Edna visited Cape Cod, with Carol doing most of the damage. High tides flooded at least 250 acres of bog with salt water, washed out hundreds of feet of dike and many flumes, sometimes leaving heavy deposits of silt, salt, and debris. In many cases the salt water was driven into coastal ponds and reservoirs rendering them for months unsuitable to use for frost or winter protection.

—*C. E. Cross, G. B. Rounsville, J. R. Beattie.*

Cranberry Disease Investigations. In the absence of a Station Pathologist, the undersigned combined to accomplish the following: 1. On April 1, 1954, we issued a preliminary keeping quality forecast that "prospects are *fair* for general keeping of the 1954 Massachusetts cranberry crop." On June 8, 1954, we issued a final keeping quality forecast indicating "that prospects are *fair* to *poor* for the general keeping of the 1954 crop." Growers were urged to "hold the winter flood late" or to use fungicides. Our best estimate is that more growers held late water than ever before in history. Further, that the keeping quality of early water berries not treated with fungicides was generally poor, a condition

made more acute by the fact that more berries were overripe when harvested. 2. Fungicide sprays on "late-water" Early Blacks failed to improve the keeping quality. Most "late-water" Early Blacks were of excellent quality anyway. 3. Late holding of the winter flood in many bogs, including the State Bog, failed as a control for ending rot in Howes.

—C. E. Cross, W. E. Tomlinson, and I. E. Demoranville.

Weed Control in Cranberries. Studies with Dalapon are continuing. Spring applications only appear feasible, and here lesser doses, as low as 3 pounds per acre, appear to control rice cut-grass with some damage to current crop but otherwise no vine injury.

Recent testing with amino-triazole at 9 pounds per acre indicated nearly complete control of poison ivy in June and July. This treatment hurts the season's crop, but no cranberry vines appear to be killed, and fruiting is near normal the next season. The treatment is 25 times as expensive as 2,4,5-T, but many growers would pay the price to avoid cranberry vine damage.

Experiments with very dilute solutions of 2,4,5-T and 2,4,5-TP have been laid out on poison ivy, wild bean, morning glory, and loosestrife. Concentrations exceeding 125 ppm. cause vine injury, but control of poison ivy and wild bean appears possible at this level in June and July.

All experiments designed to kill brambles (Rubus) with one spray have so far failed.

—C. E. Cross, I. E. Demoranville, G. B. Rounsville.

Injurious and Beneficial Insects of the Cranberry.

Prevalence of Cranberry Insects in the 1954 Season. Cranberry weevil was more than normally destructive in Plymouth County. Blunt-nosed leafhoppers continued to increase from the previous season. All other cranberry insects were light to normal in abundance.

Control of cranberry root grubs. Root grub insecticide test plots initiated in 1953 have been kept under observation since that time. At the end of 24 months, 100 percent control was obtained with 20 pounds of actual chlordane per acre and with dieldrin, aldrin, heptachlor, isodrin, and endrin at 10 pounds of actual toxicant per acre when applied in emulsifiable concentrate formulations in 1000 gallons of water per acre.

Chlordane at 10 pounds actual per acre and dieldrin, aldrin, heptachlor, isodrin, and endrin at 5 pounds of toxicant per acre in emulsifiable concentrate form have given from 90 to 95 percent control.

Granular aldrin, dieldrin, chlordane, and heptachlor results approximate the results obtained with sprays after 24 months, but kills were obtained much more slowly than with sprays.

Safe solvents for concentrate sprays on cranberries. Severe burn of new cranberry growth has resulted from solvents used in concentrate sprays. Tests with two methylated naphthalene-type solvents produced severe leaf burning. Commercial xylene caused only very slight marginal leaf burn, and technical xylene caused no burning.

Carriers for concentrate sprays on cranberries. Three isoparaffinic oils and a water white kerosene did not injure new cranberry uprights.

A scale locally harmful on dry bogs in Plymouth county has been identified as *Cerococcus kalmiae Ferris.*

—W. E. Tomlinson, Jr.

Blueberry Insects. Blueberry maggot rendered fruit from one cultivated field unmarketable and was noticed in some numbers in several other fields. Cherry fruitworm is becoming increasingly destructive to cultivated blueberries in the southeastern part of the state.

—W. E. Tomlinson, Jr.

Beach Plum Insects. Two all purpose spray mixtures at a dilution of 10 pounds per 100 gallons gave 100 percent control of plum gouger and plum curculio. Dieldrin 50 percent wettable powder, ½ pound per 100 gallons, also gave 100 percent control of the two insects.

—W. E. Tomlinson, Jr.

Strawberry Pests. Two-spotted mites continue to be one of the major strawberry pests in the Falmouth area. Aramite sprays and dusts have given good control but some injury has resulted to plants receiving too heavy a dust application or to plants weakened by black root.

—W. E. Tomlinson, Jr.

Soil Water Studies. More than ten thousand feet of plastic tubing has been installed in bogs with the aid of a tubing attachment on a tractor. Some of these installations were made in locations with standing water. The drainage obtained with these installations has been very satisfactory, and more growers are planning to use plastic tubing.

—F. B. Chandler.

Salt in Cranberry Soils. A combination of additional drainage and a lack of the usual winter flooding has removed the detrimental effects of the saline bog. There is no record that this bog has been flooded recently. From the depth of a shell deposit and the depth of a concentrated salt layer, the salt may have been deposited 2000 to 4000 years ago.

—F. B. Chandler.

Hurricane. Hurricane Carol flooded about 250 acres of cranberry bog, and the salt water went into a number of reservoirs. The silver nitrate test for chlorides indicated a great range in salt content. The salt in general increased in situations where the water stood and evaporated. Professors Drake and Steckel assisted in sodium determinations which showed an increase in sodium with an increase in base exchange. In shallow reservoirs and ponds the salt content was quite uniform, but in deep reservoirs there was stratification with two to three times as much chloride on the bottom. Bogs exposed to normal rainfall and shallow reservoirs with an inlet had the salt removed before growth started in the spring.

—F. B. Chandler.

Cranberry Breeding. The selections are still being observed, and a few crosses were made in June 1954 for the purpose of developing new varieties lower in acid and higher in sugar.

—F. B. Chandler and H. F. Bergman
in cooperation with U. S. D. A.

DEPARTMENT OF DAIRY INDUSTRY

D. J. HANKINSON IN CHARGE

Bactericidal Effectiveness of Iodophor Detergent-Sanitizers. The bactericidal properties of an iodine liquid and an iodine powder detergent-sanitizer were found almost equal. At 25 ppm. of available iodine, both products compared favorably with 100 ppm. of available chlorine in killing *Escherichia coli*, *Salmonella typhosa*, *Micrococcus pyogenes*, *var. aureus*, and *Pseudomonas aeruginosa*, in the presence of hard water, whole milk, and dishwash soil. The iodine detergent-sanitizers can be recommended for sanitizing food utensils, if field tests substantiate results of the laboratory performance tests.

—*W. S. Mueller and A. Jarvesoo.*

Solar-Activated Flavor in Milk. The cause for this off-flavor in milk is not definitely known. One of the most widely accepted theories is that it is caused by a complex oxidation-reduction reaction involving the amino acids of milk. On the basis of this theory, an attempt was made to prevent the solar-activated flavor by adding the following antioxidants to milk: water extract of cacao shell, di-tert-butyl-para-cresol, propyl gallate, nordihydroquairetic acid and Tenox II. None of these antioxidants were really effective; however, the extract of cacao shell gave the most protection.

—*W. S. Mueller, D. J. Hankinson, and A. B. Karas.*

Keeping Properties of Washed Eggs. A detergent-sanitizer solution containing a quaternary ammonium compound was compared with plain water for washing dirty eggs with an egg washing machine. The washed eggs were stored at 80°F. and at 35°F. At various times eggs were removed from storage, and the egg contents checked for the presence of fecal streptococci. Freshly laid eggs ordinarily do not contain these organisms inside the shell. The fact that all the dirty eggs used as controls were found to contain fecal streptococci on their shell suggests that the presence of fecal streptococci inside the shell may be used as an indicator of storage quality of eggs. The use of the detergent-sanitizer solution markedly increased the keeping properties of washed eggs, and improvement was more pronounced at 80°F. than at 35°F.

—*W. S. Mueller in cooperation with Warren Litsky and Harold Basch, Bacteriology Department, and J. H. Vondell, Poultry Husbandry Department.*

DEPARTMENT OF ENTOMOLOGY

CHARLES P. ALEXANDER IN CHARGE

Investigations on European Corn Borer Control. In the experimental plots insecticides were applied June 18 and 24, and July 1, after a schedule of three applications at approximately 7-day intervals. A 96-percent Ryania concentrate with 3-percent synnergist, a 50-percent DDT wettable powder, and Malathion 25-percent wettable powder at half and normal dosage were applied as sprays. A 4-percent and a 10-percent Malathion dust and a 3-percent DDT dust were also applied in the test plots. The average stage of growth of the corn at the three applications were mid to late whorl, late whorl to early tassel, and early to full tassel, respectively. Pre-harvest records of tassel breakage and stalk infestation made July 13 indicated that all the insecticide treatments were most effective. In the plots sprayed with DDT, Ryania, and Malathion at 2-pound dosages no trace of infestation was found in approximately 300 plants. Malathion at a 1-pound dosage left 90 percent of the plants free from attack. In untreated areas of the field only 63 percent of the total plants were free from attack. The dusted plots had no injured plants. A 10-percent Malathion dust, however, caused slight injury to a few plants. Stalks shredded to reveal the number of borer larvae present showed that 60 percent of the plants in check plots contained 3 to 4 borers per plant, whereas 60 percent of the infested plants in treated plots contained only one borer each. In the check plots 75 percent of the borers were maturing larvae, some ready to pupate, whereas in sprayed plots approximately half of the borers were second- or third-stage larvae, half grown or smaller. —*A. I. Bourne.*

Tests of Compatability of Methoxychlor and Dieldrin with Captan and with a Phygon-Fermate Combination as Fungicides and Their Relative Effectiveness in Curculio Control. Both insecticides with these two fungicides were used in a fixed schedule of weekly applications through the calyx spray regardless of wetting periods (potential scab infection periods). For the rest of the season the standard recommended schedule was followed. Throughout the season almost no scab could be found on the leaves, and records of McIntosh at harvest showed only three specimens of scabby fruit in the 1600 checked. In tests of curculio control, both methoxychlor and dieldrin were very effective and gave approximately equal control. The combined record of June drops and harvested fruit showed that of a total of 4202 apples those sprayed with dieldrin showed 6.2 percent curculio injury and with methoxcyhlor 6.1 percent. Both dieldrin and methoxchlor used with Captan as a fungicide gave a slightly better record of pest control than these materials with "Phygon-Fermate," although the difference was not great. The fruit in the Captan-sprayed plots showed somewhat superior finish. Golden Delicious (very sensitive to spray injury) definitely showed more russeting in those plots where the "Phygon-Fermate" combination was the fungicide regardless of the insecticide used. —*A. I. Bourne.*

Tests of European Red Mite Control from Early Season Applications. In 1954 the miticide applications followed a schedule of sprays in the pink, calyx, and second cover sprays (June 6) with no sprays for

mite control thereafter. The object was to control the mites in early season when the overwintered eggs had hatched and infestation was still comparatively light; the sprays were timed to prevent egg laying for summer infestation. Black leaf 258 (a combination containing 8 percent Malathion) and a chlorobenzilate formulation allowed no significant build-up of mites during the entire season. On those trees the mites reached a peak of 80 to 100 mites per 50 leaves 55 days after the date of the last spray, and no foliage bronzing occurred. On the unsprayed check trees mites increased steadily to a peak of 2240 mites per 50 leaves by July 15 and slowly decreased thereafter. Foliage bronzing was evident by late June, and predacious insects became abundant during July.

—*A. I. Bourne.*

Potato Spraying Experiments. The early season brood of flea beetles was not heavy and was controlled without difficulty in the first applications. By July 21 the second brood of beetles was appearing and reached the peak of abundance about July 28. In early August a moderately heavy attack of Japanese beetles occurred in the plots. It was controlled by one application of DDT. No significant number of leafhoppers was noted at any time during the season.

Flea Beetle Control.

Applications of DDT, Chlordane, and Metacide all gave quick and effective control of flea beetles. DDT 50 percent wettable powder at 2 pounds per 100 gave 98-percent reduction over unsprayed checks in one application; Chlordane 40 percent wettable powder at 2½ pounds per 100, 97.7 percent; and Metacide emulsion, 95 percent. After a second application 7 days later, all three materials gave more than 99-percent reduction. These were used in combination with Dithane Z-78. No evidence of the development of insect resistance to these insecticides was indicated.

—*A. I. Bourne.*

Control of Onion Thrips. Insecticide applications were made on July 7 at which time the plants showed only 520 thrips of all stages per 10 plants. Sprays were all applied with sufficient pressure to secure good penetration of the tight space in the axils of the inner leaves. Although the dusts were applied as thoroughly as possible, equally good penetration was not possible. Dieldrin was shown to have a long lasting residual quality combined with a high toxicity to thrips. Aldrin showed high initial toxicity to thrips and was effective in killing onion thrips, but had a slightly less lasting residual effect. It is reported to have a fumigant action and is more volatile than dieldrin. Chlordane, parathion, and Lindane gave somewhat similar reduction of thrips population. DDT in field tests was less effective than the above-mentioned, probably because of the habit of the thrips in spending much of the time in the protected places (chits) away from toxic residues. All the insecticides with a toxic and residual (fumigating) action appeared more effective than the merely contact chemicals, except dieldrin which has (or at least seems to have) a very persistent residual action as well as high immediate toxicity. Of slightly less effectiveness and lasting protection were toxaphene and heptachlor, which gave excellent initial kill but allowed some appreciable build-up

of thrips after a 7-day interval. Malathion wettable powder gave almost the same results, although in the emulsion form it showed excellent residual effect.

—*A. I. Bourne.*

Insects in Relation to Forage Crops in Massachusetts. Surveys of alfalfa and clover fields, especially throughout the Connecticut Valley area, were made to determine the insects present, their relative abundance, and their economic effect upon forage crops. Special attention to plantings in the lower valley has thus far revealed no attack by Alfalfa Weevil, a most serious enemy of alfalfa in near-by areas. Spittlebugs and Lygus bugs were generally present, but not in numbers to threaten the crop. Both appeared after alfalfa was well advanced, and plentiful rainfall neutralized their attack. Leafhoppers, which normally constitute a serious threat during late summer after the second cutting, especially in dry seasons, were comparatively scarce and in no instance caused appreciable injury.

—*F. R. Shaw and A. I. Bourne.*

Effect of Insecticides upon Beneficial Insects. The occurrence and effectiveness of coccinellids in relation to spray chemicals were studied for the purpose of investigating the possible use of predators to supplement sprays in aphid control on young, nonbearing fruit trees. The study was sponsored by the Massachusetts Society for Promoting Agriculture. *Adalia bipunctata* was the most important coccinellid predator of apple aphids observed in young, nonbearing orchards. In Amherst and Waltham, coccinellids were numerous and produced lower population levels and earlier seasonal decline of aphids. In Warren, only a few coccinellids were found, although aphids were abundant and no sprays were applied. In Groton, grower applications of malathion were detrimental to coccinellids and did not eliminate aphids with repeated applications. Treatment of sample trees with DDT and methoxychlor eliminated coccinellids with little effect on aphids, but treatments of dieldrin and nicotine did not eliminate coccinellids. TEPP and malathion treatments killed coccinellids present and also reduced aphids, which indirectly excluded ladybeetle populations. Generally, when aphids were present but not excessively abundant, new growth was not considerably less than when aphids were absent.

—*J. A. Weidhaas, Jr.*

Control of Insect Pests of Shade Trees and Ornamental Shrubs. To meet the needs of arborists, landscape gardeners, nurserymen, tree wardens, moth superintendents, and home gardeners the newer pesticides are studied for insect control and possible injury to plants.

INSECT CONTROL TESTS (WITH HYDRAULIC SPRAYERS.)

The amounts of pesticides in parentheses are per 100 gallons of water.

LATE DORMANT APPLICATION

Snowball bush aphids: Control was complete, and all aphid injury was prevented by an application of a 50-percent malathion emulsifiable concentrate (2 pints) just before the buds opened. Although excellent

mortality of aphids resulted when the spray was applied soon after the buds opened, some aphids had already injured the unfolding leaves.

Eastern spruce gall aphids: Very promising results were had with a 57-percent malathion emulsifiable liquid (1.6 pints).

Cooley's spruce gall aphid: Very promising results were had with a 57-percent malathion emulsifiable liquid (1.6 and 2 pints).

FOLIAGE APPLICATIONS

Birch leaf miner: Very promising prevention of damage was had with a 57-percent malathion emulsifiable liquid (1.5 pints) applied when the largest mines were very tiny and some unhatched eggs were still present. Excellent kill of larvae in small to large mines was also obtained (2 pints).

Spruce mites: Excellent control was had with a Karathane emulsifiable liquid (1 and 2 pints) and 25-percent wettable powder (1.3 pounds), and with a 57-percent malathion emulsifiable liquid (1.5 pints). Very good control was had with a Sulphenone emulsifiable liquid (1 and 2 pints); the 50-percent wettable powder (2 pounds) was apparently slightly less effective.

Mites on willow: Excellent control was again had with a 57-percent malathion emulsifiable liquid (1.5 pints).

Mites and aphids on elm: Of several miticides that were added to a xylol base 35-percent DDT emulsifiable liquid (2 pints) or to a 24-percent methoxychlor (Marlate) emulsifiable liquid (2 pints), best results against mites were had with a 57-percent malathion emulsifiable liquid (1.5 pints) and with a 30-percent Aramite emulsifiable liquid (0.75 and 1.5 pints). Malathion also gave excellent control of aphids on elms. Aphids produce much of the sticky honeydew that falls from elms in summer, coating the foliage and spotting everything beneath the elms including cars. Mites and aphids are commonly found together on elms, especially in July and August. No spray injury resulted from any of the above treatments.

SPRAY INJURY TESTS (WITH HYDRAULIC SPRAYERS). No foliage injury resulted from applications of the following pesticides on many different broad-leaved and some needle-leaved plants. The figures in parentheses indicate the amount of pesticide per 100 gallons of water and also the air temperature and relative humidity during the treatment.

DORMANT APPLICATIONS: Superior oil (2 gallons, 60°F., 63 percent), 57 percent malathion emulsifiable liquid (1.6 pints, 73°F., 39 percent).

MAY FOLIAGE APPLICATIONS: 50 percent Sulphenone wettable powder (2 pounds, 57°F., 61 percent), 25 percent Karathane wettable powder (1.3 pounds, 57°F., 61 percent).

JUNE FOLIAGE APPLICATIONS: Superior oil (1 gallon, 69°F., 47 percent), 46 percent malathion emulsifiable liquid (1 quart, 76°F., 41 percent).

—*W. B. Becker.*

Spraying Standing Pine Trees to Keep Out Borers (Hydraulic spray applications). By spraying standing pine trees in early spring and immediately girdling them deeply to kill them and to invite attacks by secondary bark and wood-boring insects, it was found that with suitable

spraying equipment, BHC emulsions, diluted in water and containing as little as 0.2 percent gamma isomer, could be applied thoroughly enough to standing pines to give complete protection against infestations by all borers for one entire season. These results closely parallel earlier results with standing pines and with cut logs. BHC emulsions at 0.1 percent, 0.2 percent, and 0.4 percent gamma isomer content have not yet noticeably injured foliage on a wide variety of living, needle-leaved evergreens that were sprayed during the dormant or foliage seasons. Living broad-leaved plants have not been noticeably injured by dormant spray applications at these same concentrations, but many have been severely damaged by applications during the growing season.

This spray may be useful on evergreens or dormant hardwoods that are weakened from any cause and, therefore, apt to be killed by secondary bark and wood-boring insects.

—W. B. Becker, in cooperation with the Department of Forestry.

Studies of the Insect Vectors of the Dutch Elm Disease Fungus. *Effect of Some New Insecticides on Twig Feeding by Elm Bark Beetles (Hydraulic spray applications).* Endrin, malathion, BHC, and Heptachlor emulsion sprays containing up to 2 percent active ingredient were found less effective than the 2 percent DDT or methoxychlor emulsions, which have consistently given the best and longest lasting protection against twig feeding.

Effect of Some Town Spraying Practices on Twig Feeding by Elm Bark Beetles (Hydraulic and mist blower spray applications). Through 1954, laboratory twig-feeding tests with twigs from living healthy elms sprayed with DDT by several individual towns have yet to reveal any elms protected nearly as well as elms carefully sprayed in our own tests with the required amounts and type of DDT spray. On many town-sprayed elms, twig-feeding was almost the same as on the unsprayed checks; sometimes it was more.

Spraying Standing Elms to Prevent Breeding by Elm Bark Beetles (Hydraulic spray applications). Previously it had been found that a one-percent DDT emulsion applied to all bark surfaces of elm logs prevented elm bark beetles from entering to breed for one complete season and also killed those already present when they emerged. With proper use of suitable hydraulic spraying equipment, spray coverage was thorough enough on 70-foot standing elms to prevent beetles from entering dead bark to breed for one season when 1 percent and 2 percent DDT emulsions were used. The effects on emerging beetles are being studied. DDT emulsions that are not injurious to plants at these high concentrations are essential for this work because spray directed at tall trees may drift over many other near-by plants.

—W. B. Becker.

Control of Insects on Cucurbits in Relation to Yield Insect Control.

Striped Cucumber Beetle: In replicated field plots 2 percent endrin dust and 5 percent methoxychlor plus 8 percent Maneb dust gave outstanding control for five days without plant injury.

Squash Borer: 2 percent endrin dust, 1.5 percent dieldrin dust, and 2.5 percent aldrin dust gave satisfactory protection of a light natural infestation when applied July 1, 8, and 22.

Yield: Although natural pest damage on untreated plants was not severe enough to cause a significant decrease in yield, technical increases were obtained on summer squash, Buttercup, and Hubbard squash when endrin dust was applied. Malathion and Captan dust also produced small but consistent increases on all varieties.

Taste Tests: In cooperation with the Department of Food Technology, cucumbers, summer squash, and Hubbard squash were subjected to taste tests. The pesticides that produced off-flavor most consistently were Malathion and methoxychlor. Maneb and Captan fungicides also indicated slight flavor contamination.

—W. D. Whitcomb and W. J. Garland, Waltham.

Control of Injurious Insects and Mites with Aerosols in Greenhouses. A series of aerosol treatments on red spider infested carnations showed an average mortality with phosphate miticides of 60.9 percent compared to an average mortality with nonphosphate miticides of 92.8 percent, indicating phosphate resistant mites. With phosphate resistant mites, greater mortality resulted from aerosol treatments at 50 percent than at 70 percent relative humidity and at 60°F. than at 70°F., which is contrary to previous data on nonresistant mites. Four-hour exposures killed about 6 percent more mites than two-hour exposures.

—W. D. Whitcomb and W. J. Garland, Waltham.

Materials That Show Promise in Insect Control. (a) For control of cabbage maggot on early cauliflower, nearly perfect protection was obtained with dieldrin, aldrin, and heptachlor. Drenches of wettable powders or emulsifiable concentrates of these insecticides produced 9 to 11 percent more satisfactory heads than applications of dusts or granules. Plants that received two applications of dust yielded 8 percent more No. 1 heads than those receiving one application. (b) The cabbage maggot seriously damaged all turnips planted from July 29 to August 26, indicating that there was no maggot-free date in that period, but insecticide applications August 26 to September 9 were about twice as effective as those applied August 12 or 19. The most effective insecticides were dieldrin, endrin, and heptachlor; granules of these insecticides in soil applications were more effective than dusts applied to the growing plants. (c) Practical control of fruit pests, averaging 85 percent or more usable fruit, was obtained with five to eight applications under home orchard conditions with a "general purpose" spray composed of Malathion 25 percent wettable powder (20 percent), Methoxychlor 50 percent wettable powder (30 percent), Captan 50 percent wettable powder (30 percent) and inert material (20 percent) at the rate of one pound in 10 gallons of water. Satisfactory results were produced on apples, pears, peaches, cherries, and grapes. Apples required nine applications, peaches eight, pears six, and cherries and grapes five.

—W. D. Whitcomb and W. J. Garland, Waltham.

Control of Plum Curculio in Apples. In orchard trials the addition of the fungicides, Glyodin, Captan, ferbam or wettable sulfur, to methoxychlor or dieldrin had no significant effect on the control of plum curculio on apples. In spite of a persistent residue, dieldrin failed to maintain maximum protection when the second cover applications were omitted.

—W. D. Whitcomb and W. J. Garland, Waltham.

Studies of Apple Maggot and Control. Soil treatments with dieldrin and heptachlor granules at the rate of three pounds actual toxicant per acre and with drenches of dieldrin wettable powder or emulsifiable concentrate diluted to one pound toxicant per 100 gallons applied at one pint per square foot, each reduced the emergence of apple maggot flies 75 to 85 percent. However, this is not adequate control under test conditions.

—W. D. Whitcomb and W. J. Garland, Waltham.

Control of Insect Pests of Ornamentals with Systemic Insecticides. Aphids in spruce galls and a rust mite on French lilac were killed by a soil drench of .2 and .1 milliliter per liter of 25 percent Systox. Severe plant injury resulted from soil drenches of 23 percent Systox .4 milliliter per liter on elm (dry soil) and holly. In preliminary tests, Japanese beetle, rose chafer, and elm leaf beetle were repelled from potted elm treated with Systox.

—W. D. Whitcomb and W. J. Garland, Waltham.

Studies of Red Spider Mite on Greenhouse Crops. Soil drenches of 23 percent Systox in water at the rate of one ounce per 100 square feet reduced red spider mite on carnations from about 10 mites per leaf to none in 60 days. When two ounces of Systox per 100 square feet was applied, very slight tip burn of leaves resulted in seven to 10 weeks, but severe tip burn and spotted leaves in seven to eight weeks followed the application of four ounces per 100 square feet.

—W. D. Whitcomb and W. J. Garland, Waltham.

FEED, FERTILIZER AND SEED CONTROL SERVICES

JOHN W. KUZMESKI IN CHARGE

The feed, fertilizer, milk testing, and seed laws are administered as one service, and the operations of each, with the exception of the milk testing law, are reported in annual control service bulletins.

Under the milk testing law, 6,689 pieces of Babcock glassware were calibrated, and 149 certificates of proficiency in testing were issued. All milk depots and milk inspection laboratories in the Commonwealth were visited at least once to check apparatus and general conduct of the work.

In addition to the regulatory work, the Feed, Fertilizer and Seed Control laboratories have examined feeds, fertilizers, seeds, and other agricultural materials for citizens of the Commonwealth without charge, whenever the results were considered of interest to the general public or to the Control Services.

Considerable work has been done on research projects in cooperation with other departments of the University and Experiment Station. The results of such work are reported by the departments originating the projects.

The Soil Testing Laboratory has tested 2,377 samples.

DEPARTMENT OF FLORICULTURE

CLARK L. THAYER IN CHARGE

Effect of Iron Chelators on Nutrition of Roses. Three rates of application of a chelating agent, Na_3EDTA, at 0.8, 4.0, and 20 ounces per 100 square feet of soil, superimposed over three levels of phosphate treatments prior to planting of roses, caused injury to the plants. The injury varied in degree from slight with the 0.8-ounce treatment, to moderate with the 4.0-ounce rate, and very severe with the 20-ounce rate.

Injury symptoms showed as severe veinal chlorosis of the leaves with eventual defoliation of the plants. Such defoliation was less at the lower rates of treatment and severe at the highest rate. Root injury also was caused by the treatments. Plants treated with the lower rates of the chelating agent slowly recovered and grew normally.

After ten months, plants severely injured by treatment with the 20 ounces of chelating agent slowly regained normal growth. Flower production was significantly reduced at the highest rate.

Considering these findings, it would be undesirable to plant roses immediately after applying chelating agents to the soil.

—H. E. White, Amherst.

Effect of Nutrient Elements and Light on Carnations. A boron deficiency in all the carnation plantings during the past year prevented the successful completion of experiments designed to determine how production and quality were affected by altering night temperatures in relation to the amount of sunlight received during the day. Abnormal development of flower buds, death of the growing point, a shortening of internodes, and an excessive development of axillary shoot growth were characteristic symptoms of boron deficiency in carnations. Applications of boron as sodium borate or in complete mixtures of minor elements corrected the deficiency on cut-back plants.

—J. W. Mastalerz, Waltham.

Factors Affecting the Rates of Respiration, Water Absorption and Transpiration of Cut Flowers. The rates of transpiration and water absorption for cut roses were higher at room temperature than at 32°F. At room temperature with a relative humidity of 90 to 95 percent, water absorption and transpiration were reduced approximately one-half, but no increase in the life of cut roses was recorded as occurred with cut carnations. A moving air stream increased the transpiration and reduced the quality of cut roses.

—J. W. Mastalerz, Waltham.

Low Temperature Storage of Cut Flowers and Cuttings. Flower production and quality were similar from carnation cuttings obtained on mother blocks grown at three different temperatures and stored for four months at 31° F. Particle size of the rooting medium (perlite) had no effect on the storage quality of rooted carnation cuttings.

Removing varying amounts of the basal portion of unrooted chrysanthemum cuttings after storage at 31° F. did not affect subsequent rooting, and no interaction with a rooting hormone occurred. The

cause of necrosis of the growing point of unrooted chrysanthemum cuttings during storage was not related to various treatments prior to storage. Varietal response to storage injury was observed. Rooted cuttings of several varieties of ornamental Ivy were successfully stored at 31° F. for one month, but cuttings of other foliage plants were killed.

—J. W. Mastalerz, Waltham.

Effect of Steam Sterilization on Massachusetts Greenhouse Soils The effect of steam sterilization indicates that the trends for phosphorus at the end of a two and one-half month period were the same with no significant difference between four treatments. Steaming resulted in more available manganese and a slight increase in pH in the same period. The addition of fertilizer increased the soluble salts markedly over those soils with no fertilizer added and steamed. The trends for nitrates, ammonia, iron, calcium, and potassium are yet to be determined.

—F. W. Campbell, Waltham.

Effect of Light on Prolonged Chrysanthemum Bloom and Change of Flowering Habit. Growth of potted chrysanthemums in equal parts of peat moss and sand or peat moss and perlite was comparable to growth in a composted soil. Peat and perlite mixtures were considerably lighter in weight than soil or peat and sand. Plants grown in plastic pots with these artificial mixtures were comparable to those in clay pots.

Regular applications of 2,4,5-triiodobenzoic acid (TIBA) did not promote the development of chrysanthemum flower buds under long-day conditions.

—J. W. Mastalerz and F. J. Campbell, Waltham.

Storage and Curing Treatments of Eucharis-Lily Bulbs. Bulbs, graded in size from 1½ to 2½ inches in diameter, were subjected to a hot water bath treatment at a temperature of 110° F. plus or minus one degree for 2, 2½, 3, 3½, and 4 hours. The hot water treatment retarded top growth significantly over untreated bulbs and did not induce earlier flowering. Interruption of the growth cycle of established bulbs at different intervals of time did not influence flowering.

—H. E. White, Amherst.

Treatments of Greenhouse Rose Soil with Synthetic Soil Conditioners. The purpose of this experiment was to determine the effect on the physical structure of a greenhouse rose soil with the use of two soil conditioners, Aerotil and Krillium 631. They were applied at a high rate and a low rate to the soil before steam sterilization, after steam sterilization, and without steam sterilization. The experiment was to have continued for a period of three years.

The experiment would have terminated in June, 1955, at which time the soils were to have been sampled and analyzed. Unfortunately, in the meantime, the commercial grower in whose greenhouses the tests were being conducted, unknown to the research personnel, removed the plants and the soil from the experimental benches. Therefore, the experiment was automatically terminated.

—H. E. White, J. E. Steckel, and K. J. Kucinski, Departments of Florculture and Agronomy.

Response of Snapdragons to Daylength and Temperature. Snapdragons were most sensitive to increased daylength at a stage of maturity measured by four to eight developed leaves. Delaying the application of lights for six weeks or removing lights six weeks after benching improved quality without increasing the time to flower as compared to plants lighted continuously. The response to increased daylength was similar at temperatures of 50° F. and 60° F.

—J. W. Mastalerz and F. J. Campbell, Waltham.

Timing of Carnation Crop Production. This report is based on a portion of a New England regional project being conducted simultaneously at the Universities of Connecticut, Rhode Island, Maine, and Massachusetts (including Amherst and Waltham). The purpose of such a project is to determine what planting dates will furnish carnation crops at desirable market periods under different climatic conditions in the several New England States. The data for the first year's study at Amherst indicate that the carnation crop planted May 14, 21, and 28 tended to reach its peak in October and November with a second peak occurring in April, May, and June. Carnations planted June 4, 11, and 18 reached their peak in November and December with a second peak in May and June but produced about 20 percent less flowers for the twelve month period as compared with the May plantings. Calculating production on a square foot basis of growing area, the May plantings produced 31 flowers per square foot as compared to 25 flowers for the June plantings.

—H. E. White, Amherst.

Sharp production peaks occurred after a single pinch. Additional pinches delayed the appearance of the first crop, and production was more uniform throughout the year. Quality or splitting of the calyces was not related to planting or pinching dates and methods.

—J. W. Mastalerz, Waltham.

Statistical Summary of the Floriculture Industry in Massachusetts. This project has been completed, and a manuscript has been submitted for publication. The findings illustrate clearly the importance of the Massachusetts floricultural industry in the nation. These data present in a clear, concise form, information worthy of serious consideration by all who are interested in the present condition and future welfare of this important agricultural industry.

—R. A. Jester, Amherst.

Survey of Consumer Acceptance of Various Floricultural Products. This survey is being conducted by mail. Names are selected at random from the Northampton district telephone directory. The questionnaire returns have been extremely gratifying, and the information being compiled seems pertinent and valuable.

—R. A. Jester, Amherst.

DEPARTMENT OF FOOD TECHNOLOGY

C. R. FELLERS IN CHARGE

Thiamine Destruction during the Heating of Low Acid Foods at Temperatures from 228° to 300° F. Studies on the rate of destruction of thiamine in buffer solutions and strained carrots, green beans, peas, spinach, beef heart, beef liver, lamb, and pork have been completed. The thermal destruction of thiamine was found to be a first order reaction. Increases in temperature have less effect on thiamine than they do on bacterial spores as shown by Q_{10} values, which are 2.5 for thiamine and 10 for Putrefactive Anaerobe #3679 spores. The differential effects of temperature on spores and on thiamine indicate that improved retention of the vitamin in canning may be obtained through the use of high-temperature short-time sterilization procedures.

—E. Feliciotti and W. B. Esselen in cooperation with Department of Agricultural Engineering.

Thermal Activation and Germination of Spores of Putrefactive Anaerobe No. 3679 (A standard test organism used in the derivation of canned food process times). A sublethal heat treatment or thermal activation is required to induce germination and growth of many spores in a given spore suspension. As the length of the heating period is increased, more of the spores will germinate until a maximum is reached. After this, the number of spores that are recoverable declines at a logarithmic rate, which suggests that the spores are being killed. The data indicate that for any given temperature, the death rate is logarithmic, even when the spores are not fully activated. Spores become activated at a given temperature at a rate which is dependent upon the number of remaining nonactivated spores in the suspension. The rate of activation at a given time appears to be directly proportional to the number of nonactivated spores, and thus is similar to a first order reaction.

—T. D. Miller and W. B. Esselen in cooperation with Dept. of Agricultural Engineering.

Thermal Resistance of Peroxidase Enzyme Activity in Vegetables. Emphasis has been placed on a determination of the heating times at different temperatures (215° to 300° F.) that are required to prevent the regeneration of peroxidase activity in vegetable purees during subsequent storage after heating. Green beans, broccoli, and turnips contained peroxidase of unusually high heat resistance. This high heat resistance is of particular significance insofar as heat treatments required to prevent enzyme regeneration are concerned. Time and temperature relationships for processing, especially in high-temperature short-time canning, should be based upon the irreversible denaturation of the enzyme activity as determined by tests to show the presence or absence of regeneration, as well as the destruction of bacterial spores.

—W. B. Esselen and E. E. Anderson.

Effect of Bisulfite Dipping Solution on Thiamine Content of Pre-peeled Potatoes. After 15-second dips in sodium bisulfite solutions containing 10,000 ppm. of SO_2 and after storage for 8 days at 35° F., pre-peeled whole Katahdin and Sebago varieties lost 11 and 13 percent,

respectively, of their original thiamine content. However, under similar conditions, these same varieties prepared in the form of French fries lost 47 and 30 percent, respectively, of their thiamine content.

—E. E. Anderson, W. B. Esselen, and E. Feliciotti.

Dietetic Canned and Frozen Fruits. Taste panel data on the acceptabilities of frozen and canned peaches, pears, blueberries, cherries, plums, and raspberries prepared as water packs and sweetened with sucrose, sucaryl, and saccharin were statistically evaluated. Sucrose packs were consistently rated as most acceptable, the water packs least acceptable, and the synthetically sweetened packs intermediate.

—E. E. Anderson, W. B. Esselen, R. A. Lampi.

Darkening of Vegetable Tissue during Processing. When fruits and vegetables are heat-processed for sterilization, their pigment-free tissue discolors. Using pigment-free green bean purée as the experimental material, tests were carried on to determine what chemical constituents are involved in the browning. Thus far, it has been observed that although cellulose itself is not involved, other polysaccharides associated with it are.

—G. E. Livingston and A. Roseman.

Causes of Softening of Salt Stock Pickles. The cause and control of softening of fermented cucumber pickles have been studied in a near-by pickle plant and in the laboratory. Although no specific conclusions can be made at this stage, much valuable data on fermentation procedures, testing methods, and characteristics of soft and firm cucumber pickles have been obtained.

—E. E. Anderson, R. A. Lampi, and W. B. Esselen in cooperation with C. L. Thomson, Vegetable Gardening Dept.

Role of Sugar and Organic Acids in the Inhibition and Destruction of Acid Food Spoilage Organisms. An investigation is in progress on the effect of varying concentrations of sugar (as a source of soluble solids) and acetic acid on the inhibition of growth of five typical spoilage organisms (yeasts and lactobacilli) in pickle relish, corn relish, French dressing, mayonnaise, and pickled herring. The results obtained indicate that the composition of the individual product has an important bearing on the acid and soluble solids levels required to prevent spoilage. The greater the nutrient content of the product, the higher the acid and soluble solids concentration required for preservation and inhibition of microbial growth.

—W. B. Esselen, E. E. Anderson, and H. Miller.

Poultry Freezing. The effect of freezing method and rate, and type of packaging on the color of semiscald and subscald poultry has been investigated. The surface color of frozen poultry is related to the rate of freezing. Slow freezing results in darker colored birds, particularly if the birds have been subscalded. With rapid freezing, good color and appearance were obtained with both semiscalded and subscalded poultry.

With subscald poultry, rapid freezing and a tight-fitting package are important in the production of a finished product of good appearance.

—W. B. Esselen, A. S. Levine, and I. J. Pflug in cooperation with Departments of Agricultural Engineering and Poultry Science.

Prepackaged Spinach. Fresh spinach dipped in dilute solutions of streptomycin or terramycin or both had a longer shelf life because of inhibition of bacterial soft rot. The inclusion of maleic hydrazide in the dipping solution was also beneficial because of its ability to inhibit the respiration rate of the spinach. This respiratory inhibition was evident only in the presence of the antibiotic; maleic hydrozide by itself acts as an over-all respiratory stimulant.

—F. J. Francis, H. D. Brody, and H. Miller.

Prepackaged Peeled Carrots. Prepeeled carrots would probably enjoy considerable sales popularity if a suitable method of preserving their quality was available. A series of chemical treatments including acid, sulfite, antioxidant, and antimicrobial agents have been investigated. A citric acid dip combined with a mixture of sorbic acid and calcium propionate was effective in inhibiting microbial growth and maintaining a bright attractive appearance.

—F. J. Francis, H. D. Brody, and H. Miller.

Effect of Freezing on Chemical and Physical Characteristics of Egg Yolk. Experimental work has indicated that during the early stages of frozen egg storage, the viscosity of the yolk increases at a constant rate with the time of freezing, the value of the rate being dependent on the storage temperature. Upon the addition of urea, yolk viscosity also increases with time. It would appear that denaturation of lipoprotein is probably involved in the gelation mechanism. Lipoprotein experiments showed that the viscosity of a 0.1 M calcium chloride solution containing lipovitellin can be increased by freezing and thawing; however, the sulfhydryl group content was not changed.

—C. R. Fellers, A. Lopez, R. A. Lampi, and W. D. Powrie.

Color of Fresh Cranberries. A method of measuring the amount of red pigment in fresh cranberries has been developed. It is based on a photometric measurement of the color intensity of a solution obtained by an ethanolhydrochloric acid extraction of the whole fruit. A good correlation was obtained by this procedure with various samples of Early Black and Howes cranberries. The effect of cultural factors on the color of cranberries is being considered.

—F. J. Francis, P. Thompson, and W. B. Esselen in cooperation with F. B. Chandler, Cranberry Experiment Station.

Quinic Acid in Cranberries. A paper chromatography method for isolating and determining quinic acid in cranberries has been developed. Fresh cranberries were found to contain approximately one percent of quinic acid.

—I. S. Fagerson, P. Thompson and C. R. Fellers.

Stability of Color in Strawberry Preserves. Isolation and purification techiques for the major pigment of strawberries, pelargonidin—3-monoglucoside, have been refined. A hitherto unreported pigment constituent of strawberries, cyanidin monogalactoside, has been isolated and identified. A method of biosynthesizing C_{14} labeled strawberry pigment has been developed, and small quantities of radioactive pigment have been obtained in crystalline form. Three methods of increasing color stability of strawberry preserves appear promising: (a) the use of strawberries containing a minimal amount of natural ascorbic acid; (b) the substitution of other sugars for at least part of the sucrose, so as to reduce the fructose content; and (c) the addition of a stabilizer, such as quercetin, subject, of course, to official sanction.

—G. E. Livingston, C. R. Fellers, P. Markakis, M. V. Steinberg, and R. V. Decareau.

Bitter Flavor in Cucumbers and Pickles. Bitter tasting cucumbers have been reported from time to time by pickle processors as well as by pickle and cucumber consumers. Since there is little published material concerning the occurrence of this bitterness, it is difficult to estimate the frequency and seriousness of the problem. An investigation has been made to determine whether or not locally grown cucumbers might normally contain small quantities of bitter substances previously isolated from Cucumis species in South Africa. Tests made on normal mature fresh cucumbers of several varieties showed no evidence of the presence of the bitter compounds cucumis and leptodermin.

—I. S. Fagerson and T. Wishnetsky.

Stability of Peroxidase in Salt Stock Pickles and Pickle Products. Inasmuch as off-flavors in various pickle products have been associated with peroxidase activity, a study was carried out to determine the relative peroxidase concentration in commercial salt stock pickles throughout the various fermenting, curing, and storage processes as well as in the finished pickle products. Although peroxidase activity persisted throughout the curing and storage of the salt stock for ten months, there was no detectable activity in the salt stock after it was freshened. There was no evidence of peroxidase regeneration or activity in five pickle products made up from this salt stock and stored for four months at room temperature. Thus, if peroxidase is a factor in causing off-flavor in salt pickles, its effect would have to be manifested in the fermenting and storage tanks rather than in the finished pickle products.

—E. E. Anderson, R. Lampi and W. B. Esselen.

Thermal Resistance of Food Poisoning Organisms in Poultry Stuffing. The thermal death time characteristics of *Salmonella enteriditis*, *Micrococcus pyogenes* var. *aureus*, and *Streptococcus faecalis* in representative samples of bread poultry stuffing were determined. *Streptococcus faecalis* exhibited a much greater heat resistance than the other organisms tested. The addition of 10 ppm. of allylisothiocyanate, (mustard oil) to poultry had only a slight effect in lowering the heat resistance of the test organisms. The data obtained indicate that roasting procedures for stuffed poultry, based on a temperature of 165° F. in the center stuffing should be adequate to destroy these organisms if present in the stuffing.

—W. B. Esselen and R. C. Webster.

Composition, Nutritive Value, and Utilization of the Ocean Quahog. The proximate composition, essential amino acid, riboflavin, niacin, and thiamine contents of the Ocean Quahog, *Cyprina islandica*, were determined. Its protein had a high nutritive value. Its protein and fat contents increased up to spawning time in late summer and then decreased. The total ash content tended to decrease during the same period. The thiaminase content varied between different organs in the following decreasing order: gonads and digestive tract, foot, mantle, muscle, and juices. The smaller quahogs exhibited greater thiaminase activity than the larger ones. Canned minced and steamed Ocean Quahogs were of inferior quality. The quahog chowder was judged equal in quality to canned clam chowders now on the market. The quahog juice contained much flavor and could be used as a source of clam flavor or bottled as clam juice.

—*C. R. Fellers and L. Ouellet.*

Coconut Milk Product. Coconut milk containing 4-percent fat was prepared by removing the extra fat from the original coconut milk or cream. A stabilizer was added, and the milk was fortified with vitamin D, thiamine, riboflavin, niacin, ascorbic acid, iron, and iodine to provide a product that might serve as a substitute for cow's milk in areas of Asia and the Far East where coconuts are grown.

A. G. Naik Kuradi, C. R. Fellers, and G. E. Livingston.

Packaged Fresh Poultry. Fresh (eviscerated) ready-to-cook whole chicken packaged in Cryovac (vacuumized plastic film package) or Cellophane could be stored up to 10 days at 35° F. Several types of packaging materials were tested and found to affect the rate of increase of bacteria counts during storage.

—*R. F. Jackson, W. B. Esselen, and A. S. Levine.*

Effect of Pesticides on the Quality of Fruits and Vegetables. In cooperation with the Maine, Maryland, and Connecticut Agricultural Experiment Stations, we are trying to develop an accurate and reproducible organoleptic test for the detection of flavor differences in processed fruits and vegetables treated with pesticides and fungicides. A flavor test based on a 1 to 4 scoring system where 1 indicates "objectionable off-flavor" and 4 indicates "better than average flavor" has shown promise of accuracy and reproductibility. The study is being continued, and on the basis of the results obtained several modifications in the taste panel technique as well as in the treatment and processing of the crop have been recommended. Some of these are: (1) Change pesticide treatments to yield a greater range of flavors to permit the full utilization of the scoring scale range. (2) Incorporate the use of an identified standard arbitrarily defined as having "average flavor." (3) Require at least eight judges (termed "expert judges" on the basis of their ability to detect differences in flavor and reproduce their judgments as determined by previous tests) to serve on each panel.

—*I. S. Fagerson and M. Cryan.*

Quality of Processed Foods. This project, initiated in 1951, has been continued. During the past year, evaluations of the quality of frozen concentrated orange juice and frozen peas as well as canned baked beans, peaches, and peas have been made. Grading was carried out according to the U. S. Department of Agriculture standards. Results were as follows: *Frozen Concentrated Orange Juice*: Fifty-two percent of the brands were Grade A; forty-one percent, Grade B; and 7 percent, Grade D (there is no Grade C classification for this product). *Frozen Peas*: Sixty-seven percent of the brands were Grade A, and thirty-three percent Grade B. *Canned Baked Beans*: Seventy-six percent were Grade A; twenty-two percent, Grade C (there is no Grade B classification for this product); and 2 percent, Grade D. *Canned Peaches*: Forty-six percent were Grade A; forty-four percent, Grade B; and ten percent, Grade C. *Canned Peas*: Eighty-three percent were Grade A; seventeen percent, Grade C. The quality of commercial packs of the processed food examined as measured by U.S.D.A. standards is rather high. Inasmuch as the sampling covered the more widely distributed products, it appears that products of stisfactory quality are available to consumers.

—I. S. Fagerson, E. E. Anderson, K. M. Hayes, and C. R. Fellers.

Nutritive Value of the Egyptian Broad Bean (*Vicia faba*). Broad beans are a staple in the diet of the Egyptian people, but very little attention has been given to the biological value of their protein. The purpose of this study was (1) to obtain data on the nutritive value of raw broad bean proteins as a feed for animals and poultry; (2) to study the effect of germination and cooking combined, on the protein values; and (3) to study the effect of prolonged heating (simmering), a common practice among the Egyptians. It was found that the protein was 52 percent as efficient as the control (casein). Germination improved the biological value by 6 percent. Prolonged heating (simmering) decreased the biological value by 22 percent as compared with the raw bean.

—L. R. Parkinson and M. A. Megally.

Chinchilla Research. Work has been continued in an effort to develop a successful and practical method of artificial insemination. Some success has been achieved. It now appears that low-grade uterine infections may play an important role in preventing implantations. The addition of antibiotics to the buffer used in the inseminations may correct this condition. The optimum time to inseminate is still not fully understood. Fur-chewing is apparently one of the major economic problems of the industry. Its cause and methods of control are being investigated.

—L. R. Parkinson and F. A. Vlach.

DEPARTMENT OF HOME ECONOMICS NUTRITION

ANNE W. WERTZ IN CHARGE

Conversion of Tryptophan to Niacin in Human Subjects. The conversion of tryptophan to niacin as measured by the urinary excretion of niacin and its metabolite N'methylnicotinamide before and after the ingestion of tryptophan is being studied. The urinary excretion of "free" and total tryptophan is also determined. Almost all subjects showed an increase in all or some of these factors after the ingestion of the supplementary tryptophan. However, the amount of the dose recovered was from only 4 to 20 percent. The variability in the response of the individual subjects to the dose of tryptophan suggests that other dietary and metabolic factors may affect the conversion. It is probable that other metabolites not included in the analyses may be in the urine.

—Anne W. Wertz, Pearl Kane, Mary E. Lojkin, Beryl S. Bouchard, and Georgia French.

Effect of Certain Hormones on Niacin Metabolism of Female Rats. Changes in hormonal activity were produced by ovariectomy and by injections of hormones. Ovariectomy resulted in an average drop of more than 40 percent in the urinary excretion of N'methylnicotinamide. Ten daily injections of 4 milligrams of progesterone plus 0.5 microgram of estrone produced delayed increases with maximum excretions of N'methylnicotinamide exceeding the original values on the average by more than 100 percent for ovariectomized and 50 percent for intact rats. Injections of testosterone propionate in both the intact and the ovariectomized animals resulted in an immediate drop in the output of N'methylnicotinamide, which was followed by a rise to levels exceeding the control values.

—Mary E. Lojkin, Beryl S. Stone, and Anne W. Wertz.

Amino Acid Composition of Foods. Nutritionists and dietitians are in great need of material on the amino acid composition of foods. To help supply this material for the quantitative estimation of the essential amino acids in dietaries, we have determined these amino acids in a variety of protein-containing foods. The results are now being compiled in tabular form for publication.

—Anne W. Wertz, Pearl Kane, and Georgia French.

Effect of the Level of Protein in the Rations on the Composition of the Tissues of Pregnant Rats. Rations containing 8 and 15 percent protein were fed to pregnant rats and their nonpregnant littermate controls. The moisture contents of the muscle tissues, livers, fetuses, and adnexa were the same for each group. The livers and muscle tissues of the pregnant rats on the 8-percent ration contained more fat than those on the 15-percent ration. There were no differences between the groups in the percentage composition of protein in the livers, muscle tissues, fetuses, and adnexa. A significantly higher amount of *total* protein was present in the livers and fetuses of those rats fed the 15-percent protein ration. The amounts of lysine and leucine in the tissues, expressed as the ratio of lysine or leucine nitrogen to total nitrogen, was essentially the same for each group. *—Anne W. Wertz and C. M. Carr.*

Nutritive Value of Raw and Roasted Fenugreek as a Supplement to Corn. Raw fenugreek is richer than corn in essential amino acids, especially in lysine and isoleucine. Neither the location where grown nor the length of storage time appears to affect the amino acid content. Roasting of the bean for 5 minutes at 230° C. destroyed 23 percent of the lysine and 80 percent of the thiamine, but increased the niacin content by 400 percent. After 72 hours of germination the niacin value increased 188 percent. The results of a controlled paired-feeding experiment showed that rats grew better on a ration containing both corn and raw fenugreek than on one containing corn as the sole source of protein. The substitution of roasted fenugreek in the corn ration did not increase the growth of rats.

—Anne W. Wertz in cooperation with
A. El Mohandes, Dept. of Food Technology.

DEPARTMENT OF LANDSCAPE ARCHITECTURE

RAYMOND H. OTTO IN CHARGE

Hardiness of Commercially Available Rhododendrons and Azaleas in New England. Work was undertaken to discover a method of artificially evaluating the hardiness of azaleas. The method tested, which depends upon the electrical measurement of the salts coming from plant cells that have been ruptured by freezing, had been successful on roses and apples. Fifty-one varieties of azaleas were evaluated by this method and were classified as Hardy, Intermediate, and Tender. These results are in close agreement with observations made in the field.

Soil moisture levels at 75-, 50-, and 25-percent available moisture, as determined by a Bouyoucos Soil Moisture Meter, were used to find the influence of soil moisture on hardiness. No effect of the different soil moisture levels on hardiness was observed.

The following varieties have come through the winter of 1954-55 out of doors in good condition: *Rhododendron Kaempferi* Hybrids Alice, Favorita, and Martha; and the Gable Hybrids Claret, Corsage, Herbert, La Roche, Mildred Mae, Purple Splendor, Royalty, Viola, 466, and 516.

—*R. L. Ticknor, Waltham.*

Control of Weeds in the Nursery by Chemical Sprays. Ten different herbicide materials were applied as pre-emergence sprays on Rhododendrons and Taxus. The first application of chemicals was made in May and the second in July. Each treatment was replicated four times on plots 20 feet long by 2 feet wide.

After the first application, observations of weed numbers were made, but since this record was not sufficient to show the condition of the plots, weed number and fresh weight of weed tops were recorded after the second application. Chemicals that gave very good control were Chloro I.P.C. (Isopropyl N-3 chlorophenyl carbamate) at 6 pounds per acre; C.M.U. [3-(p-chlorophenyl)-1, 1-dimethyl urea] at 1 pound per acre and Karmex D W [3-(3,4-dichlorophenyl)-1, 1-dimethyl urea] at 1 pound per acre. Not so effective, but promising, was N.P.A. (N-1 naphthyl phthalamic acid) and its sodium salt at 6 pounds per acre.

No injury to Rhododendrons or Taxus was observed with any of these treatments.

—*R. L. Ticknor, Waltham.*

Herbaceous Perennial Trials. Twenty-four new varieties of plants were added to the garden in the past year.

A list of plants that have been in the garden five years or longer and still available has been compiled. This list in final form may be useful for selecting plants most adapted to this region. Two-hundred fifty varieties of garden plants no longer available commercially will be discarded.

—*R. L. Ticknor, Waltham.*

Rapidity of Growth of Nursery Stock. Propagation of Azalea (*Rhododendron Kaempferi* var. *Fedora*), Dogwood (*Cornus florida*), Mountain Laurel (*Kalmia latifolia*), Rhododendrons (various named hybrids), and *Viburnum carlesi* under a plastic tent and under an alternate mist system were compared. The mist system has proved superior with less disease and a higher percentage of rooting.

Airlayering (*Rhododendron catawbiense* var. *roseum elegans*) proved successful. Up to eight of ten layers rooted, depending on the hormone powder applied. The most effective hormone was 2,4,5 trichlorophenoxypropionic acid at 0.50 milligram per 1 gram of talc.

Starter solutions gave increased early season growth around azaleas. However, all plants were killed in fall frosts.

—*R. L. Ticknor, Waltham*

DEPARTMENT OF OLERICULTURE

G. B. SNYDER IN CHARGE

Asparagus Investigations. In the follow-up of an asparagus breeding program, which produced the new variety, Waltham Washington, efforts were made to devise methods of vegetative propagation so that the stock plants that served as the basis of the new strain could be preserved for future use. By cutting off parts of the asparagus crowns in early spring and by dipping them in fungicidal solutions, approximately 65 percent of the plants lived.

—*R. E. Young, Waltham.*

Breeding and Cultural Problems of Greenhouse Vegetables. To determine the most economical time to set out the spring greenhouse tomato crop, plants were set January 15, February 1 and 15, and March 1. Since both weather and price affect the return from this crop, this project has been carried on for several years. The 1954 crop was not so large as some of the previous crops, but the returns from the crop, after the cost of heating, still showed the February 1 planting to be the best. The cost to heat the crop set on January 15 was 25 percent more than the cost to heat the crop set on February 1.

In an experiment to determine whether removing the top of the plant October 1 would hasten maturity and increase the size of the fall crop of greenhouse tomatoes, it was found that although the fruit from the pruned plants was slightly larger, this slight difference was not significant, and the unpruned plants produced a slightly greater yield.

—*R. E. Young, Waltham.*

Vegetable Breeding for the Improvement of Quality and Adaptability. *Lettuce.* The work of breeding a strain of iceberg lettuce better adapted for the market gardener has progressed considerably during the year. Trials of a new strain of Great Lakes on growers' farms showed that although it headed better and was not so much affected by adverse weather, the harvest period was too long, and selection was needed to produce a more uniform maturing strain. A large number of commercial varieties and strains of lettuce were tried. As in the past, many strains or varieties with the same name differed in appearance and performed much differently. It is suggested that seed be obtained a year ahead and tested on growers' farms. These preliminary tests plus reliable sources for obtaining seed should guarantee satisfactory seed.

Cabbage. The work of breeding a small, green, second early cabbage for the market gardener had previously progressed to the point where the desired type was fixed but still lacked sufficient seed-producing ability. During the year, improved methods of seed production were inaugurated. By the use of bees for pollination, good seed producers could be selected. While progress was made in the incorporation of clubroot resistance in the cabbage lines and also in Waltham 29 Broccoli, the work is still in the beginning stages.

—*R. E. Young, Waltham.*

Seed Improvement.

Carrots. The results of 30 large-scale trials on growers' farms indicated that the new, dark-colored carrot named Waltham Hicolor was satisfactory in every way except one: when grown on sandy soil, it was

too long for packaging. This new carrot has been very well received by the growers and has performed well on many different types of soil. It is the result of a cross between the Field Station strain of Hutchinson and a long, thick, dark red carrot from Turkey. Stock seed has been supplied to seedsmen for increase.

Trellis Tomatoes. The work of developing a crack-resistant trellis tomato as early as Trellis 22 has continued to the point where success seems less likely. Late-strain selections have plenty of resistance to cracking, but very few of the early ones are better than Trellis 22.

Spraying the bottom cluster on trellis tomatoes with a hormone doubled the yields of the first two pickings. The plants grown on an "A" trellis did not produce as large total yields as the single trellis. The early yields were about the same.

Miscellaneous. Breeding work on Butternut squash and greenhouse tomatoes has shown some progress, but it is insufficient to justify a separate report.

—*R. E. Young, Waltham.*

Breeding Sweet Corn, Peppers, and Field Tomatoes for Massachusetts. The many trials of Golden Beauty sweet corn indicate that this hybrid has been widely adapted. On the basis of its performance, Golden Beauty was awarded a Silver Medal by the All-America Selections Committee. The hybrid named Barbecue was also received well in trials and is listed in the 1955 catalogues of two large seed companies.

Major attention was given to the development of a number of sweet corn synthetics for the development of new germ plasm. About 150 new experimental hybrids were made and as many more were tested during the year. Most emphasis is given to those strains in the earliest season of maturity.

Considerable interest was shown in the Red Jet F_1 hybrid tomato, and in general it performed very well. One seedsman has indicated his intention of offering this variety to the public as soon as we can build up a stock of seed of the parental strains.

—*W. H. Lachman.*

Weed Control in Vegetable Crops. Karmex W and DW gave promise of excellent weed control in sweet corn for periods up to six weeks at rates of one pound per acre. Trichlorobenzoic acid at one and one-half pounds per acre also prevented weed growth for six weeks without affecting yields adversely.

Three formulations of phthalamic acid seriously stunted the growth of Butternut squash plants. Three pounds of dinitro (Premerge), however, prevented the growth of annual weeds for one month without apparent harm to either Blue Hubbard or Butternut squash.

—*W. H. Lachman.*

Culture and Nutrition of Vegetable Crops. A spray of maleic hydrazide at the rate of 5 pounds of MH-40 in 100 gallons of water per acre reduced sprouting of stored Ebenezer onions from 32.4 to 1.8 percent. Plants were treated one week before harvest, and the onions were removed from storage in February. This treatment caused a highly significant reduction in sprouting.

The storage of three-quarter-inch onion sets at a temperature of 86° F. or eight weeks completely prevented the development of seed stalks in the production field. Onions grown from sets that had not received the warm storage treatment developed seed stalks on six percent of the plants.

Testing F_1 hybrid onions again demonstrated their superior yielding ability, for in the tests nine hybrids yielded more than the best standard variety where the plants were grown from transplants.

—W. H. Lachman.

Effect of Simulated Hail Damage to Selected Vegetable Crops. This project is an attempt to evaluate the degree of damage caused by simulated hail and by mechanical means on potatoes and dry beans at a given stage of maturity.

According to studies covering a four-year period, foliar or stalk damage of varying intensity during early vegetative growth reduced only slightly the yield or quality, or both, of these crops. On the other hand, similar degrees of damage applied just prior to bloom, at bloom, or from one to two weeks after bloom, reduced yields and tended to delay maturity. It is quite possible that such damage might produce an increased percentage of off-grade tubers and seeds. There seems to be a definite relationship between the degree of damage and the stage of maturity of the plant. Weather conditions following the date of damage also have a bearing on yields and quality of plants so injured.

—G. B. Snyder.

Study of Various Practices in Harvesting, Handling and Marketing Certain Native Vegetables. Asparagus and onions were studied at the farm, in transit, and on the market to determine the effects of environmental conditions and post-harvest handling practices on market quality.

In asparagus, fiber content varied somewhat when related to cutting season, size of spear, and precooling and freshening practices. Weights and temperatures of bunches varied with precooling and freshening practices. The problem of so-called "stinkers" appears to be related to bacterial activity, which is most active under moist conditions and high temperature. The use of several bactericides as rinses shows promise of reducing such bacterial activity.

Several materials and methods of pre-packing were evaluated as means of extending the shelf life of asparagus.

Many local onion growers harvest before the tops are sufficiently dried and before curing is accomplished, which results in reduction in bulb size, more damage in transit, earlier breakdown and greater infection by diseases. These practices occur most often and give the most trouble early in the season.

Onions topped mechanically need to be more thoroughly cured than those that are hand-topped to prevent staining of bulbs, bruising of necks, and a torn appearance.

—W. Bradford Johnson.

Culture and Nutrition of Pickling Cucumbers. Eleven pickling cucumber varieties are under trial to evaluate their disease resistance and suitability in this area. Three chemicals at various rates have been applied pre-emergence to pickling cucumbers to evaluate their potential for weed control in this area.

—*C. L. Thomson.*

Production of Local Vegetables for Prepackaging. Freshly harvested heads of lettuce were precooled to 40° F. and wrapped in Cellophane LSAT 300. After exposure to room temperature for two days, the heads were stored at 45° F. The variety Pennlake deteriorated in storage more rapidly (2 to 3 days) than four strains of Great Lakes (4 to 8 days). Factors of N and K levels and firmness of head had no apparent influence on keeping quality.

—*J. R. Havis, Waltham.*

DEPARTMENT OF POMOLOGY

A. P. FRENCH IN CHARGE

Evaluation of Rootstocks for Tree Fruits. A three-acre orchard of four varieties on Malling I and seedling roots was planted in the Spring of 1955. Rooted layers of Malling Merton stocks were obtained from the stool bed, which will be budded to our commercial varieties.

—W. D. Weeks.

Study of Tree Characters of Fruit Varieties. Vegetative descriptions of several new apple varieties were made.

—W. D. Weeks, A. P. French, and O. C. Roberts.

Study of Varieties of Tree Fruits. Idared and Spartan show considerable promise as commercial apple varieties. Ewart is a high quality pear.

—W. D. Weeks and Staff.

Nutrition of Apple Trees. Red fruit color from McIntosh apple trees, that received high rates of nitrogen and potassium was significantly higher than fruit from trees that received only high rates of nitrogen. Urea sprays as a source of nitrogen did not maintain satisfactory yields. Trees that are low in potassium may require treatment for two seasons to raise their potassium content to an adequate level.

—W. D. Weeks, F. W. Southwick, Mack Drake, and J. E. Steckel, in cooperation with Chemistry and Agronomy Departments.

Nature of Winter Hardiness in the Raspberry. Milton raspberry canes held at 40° F. for 5 days were injured by temperatures of −10° F. and −18° F., but canes taken directly from the field were not injured at these temperatures. Forced canes held at 40° F. for several days were characterized by a small increase in optical density, increased electrical conductivity, and the presence of starch.

—W. D. Weeks, J. S. Bailey, Emmett Bennett, and F. W. Southwick, in copoeration with Chemistry Dept.

Influence of Chemical Treatments on the Flowering and Fruiting of Fruit Trees. The growth regulating substances, naphthaleneacetic acid and naphthaleneacetamide, were effective in reducing the set of many over-bearing apple trees, when applied to trees at petal fall time or within two weeks thereafter, depending upon the variety. Larger fruit and less tendency toward alternate bearing often result from such treatments. As a chemical thinner of peaches, 3-chloro isopropyl-N phenyl carbamate shows considerable promise when applied about 30 days after full bloom.

An application of 20 ppm. of 2,4,5-trichlorophenoxyacetic acid gave excellent preharvest drop control of Baldwin apples for a month. It is much superior to naphthaleneacetic acid or 2,4,5-trichlorophenoxyacetic acid on this variety.

—F. W. Southwick and W. D. Weeks.

Influence of Orchard and Post-Harvest Treatments on the Metabolism of Tree Fruits. A 3-percent mineral oil emulsion applied as a spray just prior to harvest gave excellent control of storage scald on R. I. Greening and Cortland apples.

Respiration measurements indicate that blushed strains of McIntosh superior to striped strains as far as red color development is concerned may be potentially better keeping apples also.

—F. W. Southwick.

Survey of McIntosh Apples in Retail Stores. Two hundred samples of apples were purchased in stores throughout the State to determine the market quality of fruit offered to consumers. Two-thirds were below fancy grade chiefly because of bruises, stem punctures, and lack of red color. Forty percent of the apples displayed in stores were in prepackaged containers, and sixty percent either in bulk or in original containers. A three-pound polyethylene bag was most commonly used for prepackaging.

—O. C. Roberts.

Improvement of the Wild Lowbush Blueberry. Polyborchlorate was applied to lowbush blueberries to control weeds, especially brakes. Applications made in late May 1955 were variable in results on both brakes and on blueberries.

—J. S. Bailey.

Black-Root Rot of Strawberries. Where black-root rot of strawberries has been serious, soil fumigation with either D-D or ethylene dibromide improved growth of plants greatly.

—J. S. Bailey.

Chemical Weed Control in Fruit Plantings. Where the sod was not disturbed, Dalapon in three applications of as much as 20 pounds each has not controlled quack grass, *Agropyron repens*, in cultivated blueberries.

—J. S. Bailey.

Cause of Unfruitfulness in Beach Plums. The use of bouquets of blossoms from bushes at a considerable distance resulted in a heavy set of fruit on a group of old beach plum bushes that had never previously borne a crop.

—J. S. Bailey.

DEPARTMENT OF POULTRY HUSBANDRY

T. W. FOX IN CHARGE

Heat Tolerance and Thermoregulation in Domestic Fowl. It has been established that altered metabolic rate influences survival time under high environmental temperatures. Capons are more resistant than normal males, a fact consistent with the metabolic theory. An anti-pyrogenic drug, aspirin, had no effect on heat tolerance.

—T. W. Fox.

Interrelationship of Growth with Other Physiological Factors of Chickens. Selection for rapid and slow growth rate is continuing, with the 1955 rapid and slow-growing lines differentiating by 200 grams. This rapid response to individual selection indicates a substantial heritability for growth rate. A feather-color problem in these dominant white lines was clarified, and a method of testing for recessive white in the presence of dominant white was developed. *—T. W. Fox.*

Effect of Progesterone on Body Weight and Growth of the Domestic Fowl. Weekly injections of 2, 4, 8, and 16 milligrams of crystalline progesterone dissolved in sesame oil had no statistically significant effect on mean body weight or shank length. Progesterone did increase variability markedly in these two measurements. Comb growth and testis size were reduced by progesterone injection, as was sexual maturity in the female. *—T. W. Fox.*

Broodiness in Poultry. A line of Rhode Island Reds has been developed that has been genetically free of the broody instinct for seven generations. These birds are mediocre in egg production, averaging about 190 eggs, and are lower in viability than production-bred birds.

Reciprocal crosses have been made with high-producing birds of the Station flock and with two superior outside strains. Results to date indicate that stock from the nonbroody line are often superior breeders both for high fecundity and for freedom from broodiness.

—F. A. Hays.

Genetic Laws Governing the Inheritance of High Fecundity in Domestic Fowl. Factors that affect sex ratio in families at eight weeks have been studied extensively. Our data indicate that age of sires and hatchability of dams significantly affect sex ratio in their offspring. There is evidence that sires from high sex-ratio families transmit sex-linked lethals to their offspring.

In 1942, the flock reached a static level in egg production, about 235 eggs. There is some evidence of over-dominance and reduced genetic variability. Daughters from two random mating lines attained about the same level of production as daughters from selected parents. Limited inbreeding may also be a contributing factor.

High viability is a most important essential. Heritability estimates give a low value of about 3 percent for pullet mortality during the first laying year. Breeding from males and females whose sisters showed very low mortality in the laying houses offers considerable promise in reducing mortality. Age of parents does affect chick mortality but has

no relationship to mortality in the growing period or in the laying houses. Daughters from different sires showed a significant difference in laying house mortality.

Reciprocal strain crosses with two improved outside strains have considerable merit as a method for increasing egg production. One strain cross gave daughters averaging 278 eggs in contrast to 240 eggs in our closed flock.

Preliminary studies on 939 eggs, laid by 29 virgin Rhode Island Red pullets, incubated for 8 days, gave four possible cases of parthenogenetic development. —*F. A. Hays.*

Genetic and Environmental Factors Affecting Hatchability. High and low hatchability lines have been carried through eight generations. High hatchability depends on a complex array of heritable characters but responds well to selection. In contrast, low hatchability is more difficult to establish and is associated with viability and egg characters. Malnutrition in embryos during early development is associated with low hatchability but known lethal genes rarely appear. Through the period of this experiment the two lines have differed significantly in hatchability and in viability. Reciprocal crosses between the two lines have been started. —*F. A. Hays.*

Effects of Furoxone on Testicular Development in Male Turkeys. Three pens of 60 male turkeys each were fed the anti-blackhead drug, Furoxone, at a 0.0121-percent level for varying periods of time. No differences in age at sexual maturity or in testis size were apparent except in the group fed Furoxone continually after two days of age. In this group, 12 percent of the males were still not producing semen 8 weeks after all other birds had demonstrated their ability to do so. There were no significant differences in body weight or adrenal and thyroid gland weights that could be attributed to treatments.

—*J. Robert Smyth, Jr., and C. E. Redman.*

Effects of Diethylstilbestrol and Methimazole in a Paste Carrier on Growth in Turkey Fryers. A 2 x 2 factorial experiment involving the effects of the presence and absence of diethylstilbestrol and methimazole, a thyroid depressant on body weight of turkey fryers, was conducted. The birds were treated at 8 weeks of age and slaughtered 4 weeks later. As in previous trials, diethylstilbestrol significantly increased rate of growth. Methimazole alone did not result in any growth stimulation when compared with the controls. In combination with the estrogen, methimazole failed to show any superiority to diethylstilbestrol alone. —*J. Robert Smyth, Jr., and J. H. Vondell.*

Sperm Survival Time in the Female Reproductive Tract of the Fowl. During the past year 240 females and 58 males, representing the second generation of selection based on duration of fertility records for both sexes, were tested. The average duration in the high line was 12.3 days, and that of the low line was 5.8 days. Reciprocal matings between pretested high and low line individuals yielded average durations of fertility intermediate between the two lines. This indicates that both sexes influence the length of time that sperm cells may survive in the female reproductive tract. —*J. Robert Smyth, Jr.*

Mating Activity in the Turkey. The mating activity of 80 female turkeys representing the fourth generation of selection for high and low mating frequency was tested over a 7-week observation period. At the present time the mating frequency of the high line is more than twice that of the low line. This difference has been accomplished by increasing the mating activity of the high line females.

—*J. Robert Smyth, Jr., and Charles Redman.*

Effects of Enheptin (2-Amino, 5 Nitrothiazole) on Testis Function of the Turkey. The anti-blackhead drug, Enheptin, was fed to 120 male turkeys at 0.05 and 0.10 percent levels for varying periods of time after 8 weeks of age. Enheptin fed continuously after 8 weeks of age caused a retardation in testis size, seminiferous tubule diameter, spermatogenesis, and age at first semen yield. The retarding effects were more marked for the turkeys fed the 0.10-percent level. All males were in semen production by 36 weeks of age at which time the drug was removed. Subsequent mating tests failed to indicate any fertility or hatchability differences between the experimental and control groups.

—*J. Robert Smyih, Jr., and B. N. Levis.*

Genetics of the Length of the Incubation Period in Chickens. Two lines of White Plymouth Rock chickens differing in the time required for complete embryonic development and emergence from the egg have been established by selective breeding. Growth rate data for 504 offspring of the fifth selection generation indicated that the two lines differ in this respect. The mean 8-week weight for the early emergence line averaged 841.9 grams, whereas the late emergence line averaged 753.2 grams at this age. No selection for rate of growth has been practiced since the onset of this study. The apparent relationship between reduced rate of growth and late emergence from the egg emphasizes again the desirability of elminating the late emerging genes from a breeding flock. —*J. Robert Smyth, Jr.*

Development of Inbred Lines of White Plymouth Rock Chickens. Approximately 14 inbred lines of White Plymouth Rocks are being maintained. A wide range of inbreeding coefficients are available with the highest line having a coefficient of 67 percent. Extensive observations are being made in two general fields: (1) external and internal egg quality and (2) mating activity. In regard to mating activity, recent observations indicate that although inbreeding does have a depressing effect on mating activity in the male, this can be overcome by selection. Inbreeding does not appear to affect sexual receptivity in the female.

—*J. Robert Smyth, Jr., and F. P. Jeffrey.*

Genetic Resistance to *Histomonas melegrides* **Infestation in the Turkey.** In order to start a line of turkeys with genetic resistance to death from Blackhead disease, 196 nine-week-old Empire White poults were ranged on land already heavily populated with chickens. During the period when the turkeys were 9 to 14 weeks of age, 96.3 percent died of Blackhead disease. No birds were lost from this disease between 14 weeks and 20 weeks of age, at which time the survivors were moved to porches. At the onset of the current breeding season 4 females and 3 males were available for use in producing the first selection generation. A small flock of 40 females and 10 males of the same strain were reared in confinement in order to provide a control population.—*J. Robert Smyth, Jr.*

DEPARTMENT OF SHADE TREE LABORATORIES

M. A. McKENZIE IN CHARGE

General Program. In 1955, approximately 13,000 specimens (more than a 30-percent increase over 1954), including 27 different kinds of trees, were examined in laboratory and field tests. Requests concerned with pest control predominated nonparasitic troubles, tree selection questions, and tree care problems were also numerous.

Dr. Francis W. Holmes, Amherst, and Mr. Henry W. Gilbertson, Waltham, assumed duties on September 1 and July 1, respectively, to fill vacancies resulting from resignations and promotions. Enticement of personnel by more lucrative offers has plagued the shade tree program to a point where progress is constantly in jeopardy, and there is a serious burden on remaining personnel.

Dutch Elm Disease Control Testing. From July 1, 1954, to June 30, 1955, the Dutch elm disease fungus was found in samples from 17 additional towns, making a cumulative total of 325 of 351 towns in Massachusetts involved since the disease was first known here (1941, Alford, Berkshire County). Summarily, in laboratory studies by means of tissue plantings in artificial culture media, the disease fungus, *Ceratostomella ulmi* (Schwarz) Buisman, has been isolated from 31,316 samples (June 1954-55, 8483) in all 12 counties on the mainland, Dukes and Nantucket being reported as disease-free at present. The effects of 1954 hurricanes on disease spread have not been critically evaluated, but analysis of 1955-56 figures may furnish some information on this subject.

—M. A. McKenzie, F. W. Holmes, J. S. Demaradzki, T. W. Mannett, M. K. Maspero, J. G. Moline, M. M. Hart, R. A. Mankowsky.

Isonicotinic Acid Hydrazide vs. Dutch Elm Disease. *Graphium ulmi* cannot produce the pyridoxine (Vitamin B_6), which it requires for growth. It is competitively inhibited by isonicotinic acid hydrazide ("INH"). Attempts have been made to get enough of the inhibitor into elm trees to prevent or delay fungus growth without killing the trees, which synthesize this vitamin for their own use. Experiments in the Summer of 1954 established that applications by spraying, injection, and soil drench failed to prevent Dutch elm disease at 1000 ppm. and killed the trees at 10,000 ppm. Applications were made June 21, 1955, by injection from reservoirs at concentrations of 3300 and 6600 ppm. The latter treatment caused the death of a single branch in uninoculated trees, but neither concentration significantly altered the rate of death of the trees after inoculation with *G. ulmi* three days after the treatment began.

In 1955 a new modification of the reservoir system for introducing liquids into the trees worked very successfully. A Number 5 tin can with a hole at the bottom was connected to a hole in the tree trunk by a length of rubber hose at each end of which was a short glass tube piercing a cork. The cans are inexpensive and the reservoir apparatus convenient to prepare in quantity.

—F. W. Holmes, J. S. Demaradzki.

Antibiotics for Prevention of Culture Media Contamination. In the Summer of 1954 the fungus testing program of the Shade Tree Laboratories had been hampered by outbreaks of *Neurospora* (= Monilia) on the culture media. Several antifungal antibiotics were on hand, which in previous screening had failed to inhibit *Graphium ulmi* in culture. Each of these was added to cooling sterile potato dextrose agar (PDA) so that its final concentration in the agar was 100 ppm.

Cycloheximide (= Actidione) controlled contamination but also prevented the growth of Cephalosporium and Verticillium, whose presence should be determined in tests for elm wilt pathogens. Merck compound #52R5208 allowed the growth of all three wilt organisms and prevented the growth of *Neurospora*, but did not appreciably reduce the number of Penicillium colonies that grew in control plates open to the air. Subtilin, bacitracin, and distilled water additives did not prevent the growth of *Neurospora*, which overran the petri dishes by the end of 1½ days. Cycloheximide was the only antibiotic that did not delay the growth of *G. ulmi* from wood chips; none of those tested prevented such growth.

Even when the petri dishes were not sterilized in advance, those containing PDA to which cycloheximide had been added had no fungal contaminants after several days. However, they contained a suspension of bacterial colonies whose source was evidently the unsterilized antibiotic solution. Streptomycin and dihydrostreptomycin in combination with cycloheximide failed to prevent the growth of these bacteria, but a combination of penicillin plus cycloheximide prevented the growth in PDA of either *Neurospora* or the bacteria in question, while allowing the growth of *G. ulmi*. The use of these antibiotics is being reserved as a second line of defense against interference by contamination, which may sometimes evade the usual laboratory sanitary measures.

—*F. W. Holmes, T. W. Mannett.*

Availability of a Nematicide for Use on Shade Trees *in situ*. The study and control of nematodes injuring shade trees have previously been limited by the phytotoxicity of all available nematicides. Soil treatments could be made only before the crop was planted. The recently-developed nematode-inhibiting compound, 1,2-dibromo-3-chloropropane, reported not to injure certain established fruit trees, may prove useful for ornamental trees as well, providing that it does not injure them. This chemical was therefore applied as a soil drench in 5 inches of water to 3 maples, 3 oaks, and 3 elms at each of the following concentrations: 2½, 5, and 10 gallons per acre. Treatment was made on June 16, 1955, which was the first day that the soil in the nursery maintained a temperature of 65° F. for several hours. No symptoms of toxicity were noted on the trees or on the grass and weeds surrounding them. However, the growth of part of an adjacent cover crop of wheat was strongly retarded on the downhill side of the test plot. The soil was not analyzed for nematode content.

—*F. W. Holmes, J. S. Demaradzki, R. A. Mankowsky, T. W. Mannett.*

Effect of Applications of Salt to the Soil near Trees. Sodium chloride and calcium chloride were again applied weekly to the same areas treated in the winter of 1952-53, except that one area was replaced by a new one with heavier soil. Between December 23, 1954, and April 1, 1955, 15 applications in three areas were made to banked road surfaces at the standard rate used by the highway department. On December 23, 1954, in three other areas applications were made to the soil directly over the roots at double the rate and are being continued indefinitely. In the first three areas vegetation was only slightly affected, whereas in the other three areas all the grass and small herbaceous plants died. Analysis for soluble salts on July 12 showed 6, 6, and 23 ppm. in the soil of the first three areas, compared to 110, 144, and 314 ppm. in the soil of the other three areas. In the plots treated with sodium chloride, the leaves of small maple seedlings showed interveinal chlorotic mottling and appeared cup-shaped because the centers of the leaves continued to grow while the margins became yellow and then died. Small oak, elm, pine, and cherry seedlings also showed chlorotic and necrotic leaf symptoms, which first appeared early in the summer. However, trees with a diameter of more than one inch showed no symptoms until late July, when the leaves of maples treated continuously with either salt showed necrotic margins separated from the green portions by thin chlorotic strips, and the leaves of a cherry tree treated continuously with NaCl showed interveinal chlorosis. The experiment is being continued.

—*F. W. Holmes, J. S. Demaradzki, R. A. Mankowsky, T. W. Mannett.*

Experiments on Control of Insect Infestations and Fungus Diseases. Birch leaf miner, *Fenusa pusilla* (Lep.). Gray birches (*Betula populifolia* Marsh.) were sprayed May 21, 1955, with 1 pound of 25 percent wettable lindane, 2, 3, and 4 pounds of 25 percent wettable malathion, ½ pound of 25 percent wettable lindane plus 1 pound of 25 percent wettable malathion, and ½ pound of 25 percent wettable lindane plus 2 pounds of 25 percent wettable malathion each per 100 gallons of water. Gray birch trees were also sprayed May 21 with all the above insecticides, each combined with 2 pounds of ferbam. The leaves on all sprayed trees had many small mines at the time of spraying. On May 31 the trees were examined. Trees sprayed with 1 pound of 25 percent wettable lindane, ½ pound of 25 percent wettable lindane plus 1 pound of 25 percent wettable malathion, ½ pound of 25 percent wettable lindane plus 2 pounds of 25 percent wettable malathion, and 3 and 4 pounds of 25 percent wettable malathion showed nearly perfect control of leafminer. However, on all trees where malathion was applied without lindane, the mines in leaves enlarged significantly before the miners were killed. It is assumed that malathion penetrates the leaf more slowly than does lindane. Malathion at the 3-pound rate gave as good final control as the 4 pounds but required a little more time to kill miners. Application of malathion at the 2-pound rate gave 60 percent to 70 percent control. The ½ pound of lindane combined with 1 pound of malathion gave good control but was slow acting. It was observed that ferbam did not inhibit the speed or toxicity of either lindane or malathion.

Sycamore Anthracnose, Horsechestnut Leaf-blotch, and Ash Leaf- and Twig-rust. In May and June 1955, 50 trees were sprayed for the control of these diseases, which were exceptionally severe in 1954, particularly ash rust, which completely defoliated trees near coastal areas. The following sprays were applied to control all these diseases: 1 pound of ferbam, 1 pound of ferbam plus 4 pounds of 25 percent wettable malathion, 1 pound of ferbam plus 4 pounds of 25 percent wettable malathion plus 2 pounds of 50 percent wettable DDT, 2 pounds of 50 percent wettable Captan, 2 pounds of 50 percent wettable Captan plus 4 pounds of 25 percent wettable malathion, and 2 pounds of 50 percent Captan plus 2 pounds of 50 percent wettable DDT, each per 100 gallons of water. Also, all the above combinations were applied using ferbam and Captan at double the above concentrations. No phytotoxicity or incompatibility were observed. These diseases were almost nonexistent in 1955 because of relatively dry weather during leaf development. Checks appeared as healthy as the sprayed trees. Results are inconclusive.

—C. S. Chater, H. W. Gilbertson, Waltham.

Inhibiting Fruit Set on Horsechestnut. Horsechestnut trees were sprayed during full bloom May 16 and 18, 1955, with sodium 1-naphthaleneacetate (App-L-Set). Dilutions of 5, 10, 15, 20, 25, and 30 ppm. were used. Thirty parts per million completely eliminated all horsechestnut fruits. Concentrations less than 30 ppm. gave erratic results. However, all concentrations of 5 ppm. or more eliminated at least 50 percent of the fruit.

—C. S. Chater, H. W. Gilbertson, Waltham.

Evaluation of all Roadside Trees of Amherst, Massachusetts. A census was made in the Winter of 1953-54 of all the roadside trees in the town of Amherst, Massachusetts, which were on improved property (excluding privately-owned trees or street trees in the country or on unimproved lots). The value of each tree was calculated by the Spicer Formula, a revision of the Felt Formula (*Trees Magazine* 13:5:8. 1953), which takes into account the three diameter, species, location, physical condition, and the value of the lot on which the tree is growing. Data were summarized during the Winter of 1954-55. The 3584 trees counted had a total value of $600,796 and thus an average value of $167.60 per tree. Six species of maple included 1969 trees, of which 1493 were sugar maples. There were 1251 American elms, 140 oaks, 128 ashes, and 96 trees representing 11 other species.

—F. W. Holmes, H. S. Clark, J. S. Demaradzki, M. M. Hart, R. A. Mankowsky, T. W. Mannett, J. Maspero.

Hurricanes. Starting on August 31, 1954, Hurricane Carol was followed by Edna and Hazel in sequence far too rapid for cities and towns to keep pace with wind-, rain- and flood-damages to trees caused by the terrible trio. In eastern Massachusetts, 145 towns reported approximately 40,000 street trees completely destroyed, often in hazardous arrays of demolished utility pole- and wire-entanglements. The leafy tree crowns of late summer served as sails to catch wind, and friction from swaying trees

was commonly insufficient to dissipate hurricane force. Rarely were dead standing trees without leaves involved, but falling trees in full leaf toppled into homes, highways, and outside utility plants indiscriminately. Perilous clean-up work on broken trees blocking highways and complicated utility reconstruction work were completed expeditiously, but many weakened trees left standing (July 1955) have set the stage for repetition of the havoc. Post-mortem studies suggest urgent need for critical evaluation of current street-tree maintenance, and planting in relation to site and outside utility plant. The increasing incidence of hurricanes in New England since 1938 compels a realistic appraisal of street trees on the basis of a sound three point program: (1) Eliminate promptly critically located trees if in dangerous condition. (2) Correct tree weaknesses found in surveys. (3) Plan tree-planting programs to fit local conditions and tree species survival record for site in hurricanes.

—*M. A. McKenzie*

Oak Wilt. The disease is serious in 18 states, but is not known to be in Massachusetts. The area nearest to Massachusetts in which oaks are known to be afflicted is Central Pennsylvania. Oaks in Massachusetts are subject to a variety of other troubles sometimes confused with oak wilt. Considerable caution should be exercised to avoid erroneous reports. Laboratory tests are necessary to establish the identity of the causal fungus (*Endoconidiophora fagacearum* Bretz). All species of oak are affected. The spectacular nature of scouting for diseased trees from aircraft has attracted much popular interest and inquiries about the disease have been very numerous. However, the only attention given to oak diseases has been limited field examination, which has been critically curtailed to conform to other commitments of the shade tree program. At present, samples from oaks suspected of the oak wilt disease are tested by these Laboratories whenever specimens suitable for the completion of tests are received. Several years ago oaks of the Commonwealth were surveyed from aircraft by observers experienced in detecting diseased trees. A similar survey is again advisable in view of apparent success in controlling spread of the disease elsewhere if detected early and in view of the value of oaks in Massachusetts to property owners and industries.

—*M. A. Mc Kenzie.*

DEPARTMENT OF VETERINARY SCIENCE

K. L. BULLIS IN CHARGE

Pullorum Disease Eradication. During the 1954-1955 testing season 386 chicken, turkey, and pheasant flocks were tested. Among 1,204,232 samples tested 0.12 percent were found positive, which is a definite increase over the percentage (0.004) positive in the previous season. Pullorum infection was detected in eight flocks, five of which were negative the previous season. No reactors were detected among the turkeys and pheasants. It is encouraging to note that 98.54 percent of all birds tested are in nonreacting flocks.

—H. Van Roekel, M. K. Clarke, C. F. Smyser, G. H. Snoeyenbos.

Infectious Bronchitis Control. During the 1954 calendar year 1,118 flocks, representing 2,473,119 birds, were enrolled in the program. There were 1,555 requests for bronchitis virus. Flock inoculation results were as follows: 1,026 with takes; 136 with no takes; and 393, no replies. The degree of immunity produced by this vaccine has been of a high order since only a few mild breaks in immunity were observed.

—H. Van Roekel, C. F. Smyser, L. P. Beninato, L. W. Fleming, and G. H. Snoeyenbos.

Chronic Respiratory Disease, Its Transmission and Control. Egg transmission studies of chronic respiratory disease (CRD) involving a group of 430 breeding chickens revealed that 81 hens produced chicks and embryos that manifested lesions of CRD. Twenty-three hatches from these 81 hens were examined. In 13 hatches, the chicks were examined shortly after hatching, and in 10 hatches the chicks were reared in isolation and observed for CRD infection. Each hatch, at four to five weeks of age, was subjected to either bronchitis or Newcastle disease vaccine, which served as a stress factor to precipitate CRD. Chicks in six of the ten hatches manifested symptoms and lesions of CRD. Evidence reveals conclusively that CRD may be egg-transmitted. Results of limited serologic tests reveal that the hemagglutination-inhibition and agglutination tests have definite diagnostic value and may prove promising in establishing CRD-free flocks. Various antibiotics and chemicals tested for their control of uncomplicated experimental CRD revealed that they exert little, if any, beneficial influence.

—H. Van Roekel, O. M. Olesiuk, L. P. Beninato.

Immunization against Avian Respiratory Diseases. A commercial dust vaccine (combining Newcastle disease (ND) and infectious bronchitis (IB) viruses) was employed in experimental mass vaccination in commercial chicken flocks. This method was used in three different age groups of flocks: (1) initial vaccination at one to ten days, 20 flocks (38,000 birds); (2) initial vaccination four to nine weeks, 18 flocks (42,000 birds); and (3) initial vaccination 15 to 25 weeks, seven flocks (12,000 birds). Groups 1 and 2 were revaccinated at least once at an older age and in some instances more than once. In Group 1 few flocks revealed ND immune response. Group 2 flocks gave a very good immune

response to the first vaccination, and the level of immunity appeared stable. Group 3 flocks responded very similarly to flocks in Group 2. Several trials using commercial IB and ND vaccine in the drinking water have given results that induced adequate immunity to IB, but a rather low and unstable immunity for ND.

—H. Van Roekel, L. P. Beninato, L. W. Fleming, and C. D. Brandt.

Diagnostic Service. The volume of specimens was slightly below the peak load of the previous year.

Amherst. A total of 3,530 specimens was submitted for examination in 832 consignments during 1954. The specimens were classified as follows: 3017 chickens, 188 turkeys, 70 bovine, 63 porcine, 42 pheasants, 37 equine, 28 ducks, 22 ovine, 15 canine, 13 guinea pigs, 6 rabbits, 5 grackles, 4 caprine, 3 each of mink, hares, parakeets, and partridge, 2 feline, and one each of canary, goldfinch, seal, fox, and one hay sample.

A new type of exudative synovitis was identified in one turkey flock. This disorder has been recognized in chickens in various parts of the country during the past two years. The infection is caused apparently by a large virus or more probably a rickettsia, and can be prevented under laboratory conditions by administering various broad spectrum antibiotics.

—G. H. Snoeyenbos and R. W. Bennett.

Waltham. A total of 9,462 specimens was submitted for examination. The hemagglutination-inhibition test was performed on 2,292 individual serum samples.

Specimens were classified as follows: 7937 chickens, 1265 turkeys, 122 parakeets, 22 ducks, 22 rabbits, 20 canaries, 18 pigeons, 15 guinea pigs, 11 hamsters, 8 geese, 6 swans, 4 mice, 4 pheasants, 2 quail, 2 swine, and one each of heron, ovine, parrot, and seagull.

Five sporadic outbreaks of infectious synovitis were observed during the year for the first time in chicken flocks. *Acuaria uncinata* infection in a young swan and a field outbreak of nutritional encephalomalacia in young poults were each identified once for the first time at the laboratory. There was a marked increase in the incidence of ulcerative enteritis (quail disease) in young chickens. A record number (35) of erysipelas outbreaks were identified in turkeys.

—G. P. Faddoul and G. W. Fellows.

Newcastle Disease Immunization Studies. Reduced water vaccine titers of the B_1 strain resulted from environmental effects frequently encountered under field conditions. These effects could be overcome, for the most part, by using protein-type stabilizers and high titer vaccines, and by administering the virus a short time after a fasting period.

Satisfactory immunogenic response was obtained with the administration of B_1 virus in the drinking water. This response was comparable to

that obtained by ocular administration but less than that reported by spray application. The necessity of having a high virus titer in the drinking water was demonstrated.

Two strains of Newcastle disease virus have been propagated in tissue culture through 40 generations by using fluid media and embryonic chick tissues. Titers of $10^{-5.0}$ to $10^{-8.0}$ were routinely obtained by the technique used.

—R. W. Winterfield and E. H. S adale.

Mastitis Testing Laboratory. During 1954, 20,342 milk samples were tested. Of this number, 10,708 were from 15 state institution herds, 631 from the University Farm Department herd, 8,244 from 91 private herds, and 759 were tested on an experimental basis.

A pathogenic pleuropneumonialike organism was recovered from the udder of a Massachusetts goat and from her kid at post mortem. Clinically the infection resembles contagious agalactia of sheep and goats, which has caused serious losses in some parts of the world but has not been believed to exist in the United States.

Brucella ring testing was conducted on the market milk of 110 patrons of 10 dairy plants. Samples from 17 patrons were negative. Subsequent blood agglutination tests of the suspicious herds showed that an additional number were negative.

—W. K. Harris and I. M. Reynolds.

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